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THIRD ANNUAL REPORT

State Board of Forestry

1903

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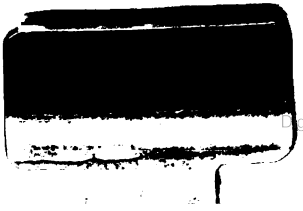

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BIRD'S-EYE VIEW OF THE RESERVATION FROM CUSTODIAN'S HEADQUARTERS ON GRAND VIEW KNOB.

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STATE OF INDIANA

THIRD ANNUAL REPORT AND DISCOURSES

OF THE

State Board of Forestry

1903

W. H. Freeman, Secretary

TO THE
GOVERNOR OF INDIANA

INDIANAPOLIS:
WM. B. BURFORD, CONTRACTOR FOR STATE PRINTING AND BINDING.
1904.

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STATE OF INDIANA,
EXECUTIVE DEPARTMENT,
INDIANAPOLIS, December 20, 1903.

Received by the Governor, examined and referred to the Auditor of State for verification of the financial statement.

OFFICE OF AUDITOR OF STATE,
INDIANAPOLIS, January 5, 1904.

The within report, so far as the same relates to moneys drawn from the State Treasury, has been examined and found correct.

D. E. SHERRICK,
Auditor of State.

January 5, 1904.

Returned by the Auditor of State, with above certificate, and transmitted to Secretary of State for publication, upon the order of the Board of Commissioners of Public Printing and Binding.

GEO. B. LOCKWOOD,
Private Secretary.

Filed in the office of the Secretary of State of the State of Indiana, January 5, 1904.

DANIEL E. STORMS,
Secretary of State.

Received the within report and delivered to the printer this 5th day of January, 1904.

THOS. J. CARTER,
Clerk Printing Bureau.

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INDIANA STATE BOARD OF FORESTRY.

OFFICIAL MEMBERS, 1903.

F. C. CARSON, President ..... Michigan City.
STANLEY COULTER ..... Lafayette.
ALBERT LIEBER ..... Indianapolis.
JOHN COCHRANE ..... Indianapolis.
W. H. FREEMAN, Secretary ..... Wabash.

Office of Secretary,
Room 93, State House, Indianapolis.

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STATE OF INDIANA, BOARD OF FORESTRY.

Indianapolis, Ind., December 1, 1903.

Hon. Winfield T. Durbin, Governor:

Dear Sir—In accordance with the law by which the State Board of Forestry was organized, we have the honor to submit herewith the manuscript of the Third Annual Report of the work accomplished the past year and discourses concerning forest cultivation as in the judgment of the Board seems imperative and for the instruction of the people of the State.

Yours respectfully,

F. C. CARSON, President.

W. H. FREEMAN, Secretary.

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INTRODUCTORY.

The past history of Indiana's forests is one not surpassed in excellence by that of any other State. At a time, about one hundred years ago, when the pioneers crossed the western boundary of the Eastern civilization, and, guided only by the familiar blaze of the surveyor's axe, wended their ways along the streams into the dense forests of oak, ash, sycamore, hickory, walnut, poplar, cherry, maple, elm, lin, beech and other deciduous trees, then covering the Northwest Territory, in search of future homes, no portion was more densely wooded than the territory of Indiana. At the beginning of the struggle for possession of the Wabash Valley by the English, the entire area of the now State of Indiana was covered with dense forests, broken only by the rivers, lakes and a few small prairie regions. But from the time these sturdy pioneers entered the territory and established themselves in the log cabin homes, the forests, tree by tree, have gradually yielded to the woodman's axe and vanished by means of the log heap and the stream to make way for fertile fields of harvest and busy cities of thriving industries and social swirl and the general advance of civilization until the present time finds the almost complete absence of virgin forest within the State's boundaries and a general timber scarcity menacing the stability of many manufacturing industries to the State and embarrassing the economic demands.

As the past history of Indiana's forests is not excelled by that of any other State, so it is with the present interest and advance of forestry in the State and by the State. For the brief time, two and a half years, forestry has been made a department of State concern, the advancement, the public sentiment and the activity are good beyond criticism. It seems that every effort which the Board made to promote and stimulate right forestry conduct was received by the people of the State with a willing response and a promptness that realized its intentions. This enthusiastic

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assistance in behalf of this prime movement from the public-spirited citizens of the State is cause for the highest praise and merit, and the Board unqualifiedly acknowledges its obligations to the Governor and General Assembly of Indiana, the public press, the officers and teachers of the public schools, the officers and members of the farmers' institutes, the members of civic organizations and the private citizens for their help and influence in the successful progress of forestry and its better establishment as a State institution.

The last General Assembly by enacting into laws S. B. 34 and H. B. 98 secured to the Board the means and the opportunity to accomplish forestry work of a good degree, and to give to the citizens demonstrative evidence and information of practical use. By the means thus afforded the Board will be able to advance forestry information from the theoretical phase to the real fact by actual performance. But let the citizens bear the following three things well in mind:

1. The Board, to enable it to conduct the experimental forestry work to benefit the public demands, must know the public wishes and desires.

2. The Board will use its best judgment in conducting experiments which will result in the best practical forestry information for the general people.

3. Forestry is not a matter of a year's development, and consequently patience, time, labor and money must be exercised and spent in the development of correct experiments and thereby right information ascertained for dissemination.

The unfolding of the present forestry organization, the bills formed for enactment into laws and the lines of forestry work now being carried forward were evolved from the inquiries made by the patrons of the office who sought knowledge pertaining to forestry interests, and the future efforts will be likewise directed.

The forestry discourses herein submitted are aimed to guide and instruct those who may wish to perform work upon their own lands and to observe forest influences. They are also aimed to give a knowledge of the character of and the plans for the State Forest Reservation and Experimental Station and a general knowledge of trees and their characteristics. The constant aim

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throughout is to direct and instruct in the most practical, common sense ways and methods.

In conclusion the Board urges the necessity for the future concerted action and interest in forestry by the entire people, as beyond doubt the time is at hand when the cultivation of forests is vital to the general welfare of the State.

INDIANA STATE BOARD OF FORESTRY,
W. H. FREEMAN, SECRETARY.

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FINANCIAL STATEMENT.

November 1, 1902, to October 31, 1903.

APPROPRIATIONS.

Annual appropriations by the General Assembly, 1901—	
Office expenses	$600 00
Salary of Secretary	1,200 00
Emergency appropriations by the General Assembly, 1903, and available Feb. 28, 1903—	
Office expenses	400 00
Salary of Secretary	400 00
Salary of stenographer and clerk to Secretary	400 00
Salary and mileage for members of Board	277 18
Purchase of 2,000 acres of land for State Forest Reservation and Forestry Experimental Station.	16,000 00
Expenses for management and labor of State Forest Reservation and Forestry Experiment Station..	2,000 00
Total appropriations for year	$21,277 18

EXPENDITURES.

Office—	
Mileage	$346 47
Stenographer to February 28	211 00
Fixtures and incidentals	176 63
Postage	220 00
Commission Expenses—	
F. C. Carson, salary and mileage as member of Board	86 50
Stanley Coulter, salary and mileage as member of the Board	73 48
Albert Lieber, salary as member of Board	58 60
John Cochrane, salary as member of Board	58 60
Reservation and Forestry Experimental Station—	
Purchase of 2,000 acres, correct titles and abstracts.	16,000 00
George Barnett, custodian	200 00

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Topographical and biological surveys and expenses.	$438 58
Team, wagon, harness and implements.....	312 78
Material for buildings and improvement.....	194 87
Manual labor and incidentals.....	853 77
Total of expenditures.....	$21,277 18

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FORESTRY LAWS OF INDIANA.

AN ACT to establish a State Board of Forestry, defining its powers and duties, and creating the office of State Forester and Secretary of said Board, and fixing the amount of his salary and allowance for his expenses.

(H. 192. Approved March 1, 1901.)

Section. 1. Be it enacted by the General Assembly of the State of Indiana, That a board is hereby created and established, which shall be known under the name of the State Board of Forestry. It shall consist of five members, who shall be appointed by the Governor, as follows: One from the membership of the State Forestry Association, one from the membership of the Retail Lumber Dealers' Association of Indiana, one from the faculty of Purdue University, one from the woodworkers of the State, who is a mechanic actively employed at his trade, and one who shall have special knowledge of the theory and art of forest preservation and timber culture, and technical knowledge of the topography of the State, and said last described member shall, upon his appointment and qualification, become and be the secretary of said board and ex-officio State Forester. All of said members of said board shall hold their offices for four years and all except said secretary and State Forester shall serve without compensation. A majority of said board shall constitute a quorum, and said board shall annually elect from its number a president.

Sec. 2. Before entering upon the discharge of their duties, the members of said board shall each take and subscribe an oath of office before the Clerk of the Supreme Court that they will faithfully and honestly discharge the duties of said offices, which oath of office shall be filed in the office of the Secretary of State.

Sec. 3. The board shall meet at least once each quarter in the city of Indianapolis, and as often as they may deem necessary upon five days' notice signed by the president and secretary, and in the absence of the president, a chairman shall be chosen to preside. The minutes of all meetings shall be recorded by the secretary in a book to be kept for that purpose.

Sec. 4. It shall be the duty of said board to collect, digest

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and classify information respecting forests, timberlands, forest preservation and timber culture, and to recommend plans and methods for forest preservation and timber culture and for the establishment of State forest reserves. The board shall, annually, on or before the first day of December, file with the Governor a report.

Sec. 5. The secretary of the board shall keep his office at Indianapolis, in a room to be furnished said board by the custodian of the State house, and shall perform such duties as are prescribed by this act or may be required by the board; and he shall, as far as practicable, submit to the associations and meetings of timber dealers, woodworkers, farmers and engineers of maintenance of way of railroads, information and facts as to forests and timber.

Sec. 6. The secretary (and State Forester) shall receive an annual salary of twelve hundred dollars and an allowance for expenses of his office and his traveling expenses not exceeding six hundred dollars. Said secretary shall give his exclusive time and attention to said office and shall not hold any other office, appointment or position other than herein provided for. The president of the board shall quarterly certify the amount due the secretary upon vouchers duly attested by the secretary before some officer authorized to administer oaths, and the amount so certified shall be paid to the secretary out of the treasury of the State upon warrant of the Auditor of State.

Sec. 7. Whereas an emergency exists for the immediate taking effect of this act the same shall therefore be in force and effect from and after its passage.

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AN ACT to amend Sections one (1) and six (6) of "An act to establish a State Board of Forestry, defining its powers and duties, and creating the office of State Forester and Secretary of said Board, and fixing the amount of his salary and allowance for his expenses," H. 192, approved March 1, 1901, the same being Sections 6628k and 6628p of Burns' Annotated Indiana Statutes, Revision 1901, and declaring an emergency.

(S. 34. Approved February 28, 1903.)

Section 1. Be it enacted by the General Assembly of the State of Indiana, That Section 1 of said act be and the same is hereby amended to read as follows: Section 1. That a board is hereby created and established which shall be known under the name of the State Board of Forestry. It shall consist of five members, who shall be appointed by the Governor, as follows: One from the membership of the Hardwood Lumber Dealers' Association of Indiana, one from the membership of the Retail Lumber Dealers' Association of Indiana, one from the faculty of Purdue University, one who is actively engaged in farming, and one who shall have special knowledge of the theory and art of forest preservation and timber culture and technical knowledge of the topography of the State, and the last described member shall, upon his appointment and qualification, become and be the secretary of said board, ex-officio State Forester and Superintendent of State Forest Reserves. All of said members shall hold their offices for a term of four years, and each of said members, except the secretary, who is hereinafter provided for, shall receive a salary of one hundred dollars per annum and mileage not to exceed three cents a mile for necessary miles traveled in attending necessary meetings of said board. Said salary and mileage shall be paid out of the treasury of the State upon warrants of the Auditor of State, and the members shall certify the amount due them, separately, upon vouchers duly attested before some officer authorized to administer oaths. A majority of said board shall constitute a quorum, and said board shall annually elect from its number a president: Provided, That members of the board heretofore appointed shall serve during the term for which they were appointed.

Sec. 2. That Section 6 be and the same is amended to read as follows: Section 6. The secretary shall receive an annual

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salary of eighteen hundred dollars. For expenses of office and traveling, an amount not exceeding $1,000; clerk, six hundred dollars ($600). Said secretary shall give his exclusive time and attention to said office and shall not hold any other office, appointment or position other than herein provided for. The president of the board shall quarterly certify the amount due the secretary upon vouchers duly attested by the secretary before some officer authorized to administer oaths, and the amount so certified shall be paid to the secretary out of the treasury of the State upon warrant of the Auditor of State. That expenses of publication shall be paid from the expense fund of the State Printing Board.

Sec. 3. Whereas an emergency exists for the immediate taking effect of this act, therefore the same shall take effect from and after its passage.

AN ACT to provide for the purchase of land by the State Board of Forestry for the purposes of a State forest reservation, laboratory of forestry demonstration and State nurseries, and to provide for the management and location of the same, and declaring an emergency.

(H. 98. Approved March 3, 1903.)

Section 1. Be it enacted by the General Assembly of the State of Indiana, That there be and is hereby set aside a sum of money out of any money not otherwise appropriated, sufficient to purchase two thousand acres of land by the State Board of Forestry for the purposes of a State forest reservation, laboratory of forestry demonstration and State nurseries, and that the sum of one dollar and fifty cents per acre annually thereafter be allowed to defray the expenses of management and labor of the same.

Sec. 2. The Board of Forestry shall purchase said land in any county or counties of the State, which, in its judgment, affords the best opportunities for the purposes prescribed: Provided, That the land so purchased shall not exceed a cost of eight dollars per acre, and the land so purchased shall be taken in title in the name of the State of Indiana.

Sec. 3. The Board of Forestry shall manage and shall establish such rules and regulations governing the management and work as are necessary to execute the plans it may project, and

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the expense of the same shall be paid quarterly from the fund designated for that purpose out of the State treasury, upon warrant by the Auditor of State when vouchers are presented to said Auditor duly certified to by the president and secretary of the board before some officer authorized to administer oaths.

Sec. 4. The secretary of the board shall receive all money to which the State may be entitled by reason of the sale of any timber, leases, contracts for the mining and removal of minerals or from any source whatever from such land, and he shall immediately pay the same over to the State Treasurer as a part of the revenues of the State, and the secretary shall give his bond, to the Governor of the State, in the sum of five thousand dollars for the faithful discharge of his duty.

Sec. 5. Whereas an emergency exists for the immediate taking effect of this act, the same shall therefore be in force and effect from and after its passage, and all laws and parts of laws in conflict with it are hereby repealed.

STATUTORY LAWS FOR THE PROTECTION OF FORESTS AND ORNAMENTAL TREES.

(Burns' Revised Statutes, 1901.)

Section 2001 provides a fine of not more than $100 nor less than $5, to which may be added imprisonment in the county jail not exceeding thirty days, for maliciously or wantonly setting fire to any woods, or for permitting a fire to pass from his own property to the injury or destruction of the property of any other.

Sec. 2040 provides a fine of five times the value, to which may be added imprisonment not exceeding twelve months in the county jail, for whoever cuts down or destroys or injures any bush, sapling or tree on the land of any other person, or on land belonging to the State or county or township, or any land reserved by county for the use of schools or seminaries, without license to do so from competent authority.

Sec. 2041 provides a fine of not more than $500 nor less than $50, to which may be added imprisonment in county jail not exceeding six months, for wilfully, mischievously or maliciously disfiguring, defacing or removing any tree, shrub or plant in or around any public or private cemetery or burial place.

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Sec. 2042 provides a fine of not more than $500 nor less than $50 for whoever shall wilfully, maliciously or mischievously and without right cut down or in any way injure any tree on a public highway.

Sec. 2048 provides a fine in any sum not more than $50 nor less than $3 for whoever removes, destroys, cuts or girdles any shade tree, or carries off or removes or in anywise injures the protecting box of any shade tree in any city, town or village of this State, provided, however, that this section shall not be construed as to prevent any owner of grounds from making any necessary alterations in the walks or trees on the same.

AN ACT for the encouragement of Forestry.

(H. 436. Law without Governor's Signature, March 8, 1899.)

Section 1. Be it enacted by the General Assembly of the State of Indiana, That upon any tract of land in the State of Indiana, That upon any tract of land in the State, there may be selected by the owner, or owners, as a permanent forest reservation, a portion not to exceed one-eighth of the total area of said tract, which shall be appraised for taxation at one dollar per acre.

Sec. 2. If such selection is an original forest, containing not less than 170 trees in each acre, it shall become subject to this act upon filing with the Auditor of the county in which it is situated, a description of such selection as is hereinafter provided.

Sec. 3. If any land owner shall plant not less than 170 trees on each acre of selected forest reservation, and shall cultivate and maintain the same for three years, then it shall become subject to this Act, as herein provided.

Sec. 4. Upon any tract selected as a forest reservation which contains 100 or more original forest trees on each acre, the owner may plant a sufficient number of forest trees which shall make up the required 170 trees per acre, when the same shall become subject to this act, as in Section 3.

Sec. 5. No land owner shall receive the benefit of this Act who shall permit cattle, horses, sheep, hogs or goats to pasture upon such reservation until said trees are four inches in diameter.

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Sec. 6. Whenever any tree or trees shall be removed or die, the owner in order to avail himself of this act shall plant other trees in place of such trees as may be removed or die, and protect said trees until they are four inches in diameter, shall plant others which shall at all times maintain the full number required by this act.

Sec. 7. Not more than one-fifth of the full number of trees in any forest reservation shall be removed in any one year, excepting such trees as may die naturally may be removed, when other trees shall be planted.

Sec. 8. Ash, maple, pine, oak, hickory, basswood, elm, black locust, honey locust, Kentucky coffee tree, chestnut, walnut, butternut, larch, tulip tree, mulberry, osage orange, sassafras and catalpa shall be considered forest trees within the meaning of this act.

Sec. 9. It shall be the duty of the Auditor in every county to keep a record of all forest reservations as the same shall be filed with him, and he shall require the owner or agent to subscribe under oath the extent and description of the land reserved, and that the number of trees is as required by this act, and that he will maintain the same according to the extent of this enactment.

Sec. 10. It shall be the duty of the Assessor to personally examine the various forest reservations when the real estate is appraised, and to note upon his return the conditions of the trees, in order that the intent of this act may be complied with. And if the reservation is properly planted and continuously cared for, he shall appraise the same at one dollar per acre.

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FORESTRY OBSERVANCE AND INTEREST OF THE PEOPLE IN THE STATE.

The spirit and conduct as concerns forestry by the citizens of Indiana is excellent. The growth of sentiment in favor of planting trees and preserving the forests is deserving of the highest commendation. The secretary in addition to the work of promoting Forestry by the State as shown by that report made 207 recommendations for tree planting and forest culture extending into all parts of the State.

The work is being well presented and received at Farmers' Institutes. Local speakers are enthusiastically urging the need of forestry attention. The public schools are observing Arbor Day with a spirit that is telling its own story in the work done by them in the tree planting on the school grounds and elsewhere for decoration. It is hoped that the schools will carry this tree culture enthusiasm forward to an observance of systematic forest culture in the respective communities.

The number of trees planted by the schools last year was 31,736, and while no statistics have been taken by school superintendents and reported it is evident from accounts given of Arbor Day observance by the schools that a far larger number was planted the present year. The number of trees planted by farmers last year was 123,675. The report for this year by the State Statistician shows that 218,495 were planted. Nurserymen report that Indiana and Ohio were planting more trees than any other States from their accounts, and their stock became exhausted very early this season. No efforts they could make were sufficient to fill the demands for the post timber trees. I do not believe the above number includes the trees planted for such purposes as the last named, as I personally know that the number given nowhere equals the number of catalpa, locust, osage, chestnut and mulberry planted for the purposes of posts, ties, telegraph and telephone poles.

It is encouraging to note the progress in tree planting and the cultivation given the forests. A trip through the State reveals signs of forest cultivation on every hand. It, however, is urged

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that more of the stable merchantable hardwoods be planted. The demands for young second growth oak, ash, hickory, elm, walnut, cherry, lin and other kinds of the best qualities of woods will far exceed the demands for the kinds now being so abundantly grown, though I do not discourage the present attempts, as there will always be a big demand for them. Forests of cultivated hardwoods will in a short time reveal growth not imagined at the present time and the returns are not nearly so distant in time as now thought.

The act of 1899 for the encouragement of forestry, by which owners of timber land could exempt a portion of their land from taxation has not proven a success. Last year there were 560 exemptions recorded by the county auditors, and the present year the number was more than double, but the assessors found in making their examinations that almost 99 per cent. of them failed to meet the requirements of the law and were rejected from the benefits of the act. The enforcement of the law proved its weakness. There are not more than two dozen exemptions now standing. The law is weak in almost every detail. I think some law should be made that will be beneficial and practical in operation for the encouragement of planters, but evidently the present law should be repealed and ninety of the ninety-two county auditors so expressed themselves, and the results justify their assertions.

The conduct of the owners who had claims and which were rejected will indicate whether the law was taken advantage of for personal gain or forestry interests by the attention and retention of the forests owned by them in the future, and will determine what should be done.

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THE STATE FOREST RESERVATION.

HISTORY AND LOCATION.

The State Forest Reservation and Station for Forestry Experimental Demonstration and State Nurseries has a historical relation which should be given full credit along with the fitness of the site for the purposes intended. By referring to the early history of the conquest of the Northwest Territory, especially that part concerning the reduction and capture of the posts, Kaskaskia and Vincennes, by General George Rogers Clark, and to the deeds of cession by Virginia in 1784, some of the historical associations connected with the territory of which the land now

CUSTODIAN'S RESIDENCE AND HEADQUARTERS ON GRAND VIEW KNOB AT THE FOREST RESERVATION, HENRYVILLE, INDIANA.

forming the above reservation is a part may be known. The following is an extract from the deeds of cession and pertaining directly to the above territory:

"That a quantity not exceeding one hundred and fifty thousand acres of land, promised by Virginia, shall be allowed and granted to the then Colonel, now General George Rogers Clark, and to the officers and soldiers of his regiment, who marched with him when the posts of Kaskaskia and Vincennes were reduced, and to the officers and soldiers that have since been incorporated into the said regiment, to be laid off into one tract, the length of

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which not to exceed double the breadth, in such place on the northwest side of the Ohio as a majority of the officers shall choose, and to be afterward divided among the officers and soldiers in due proportion, according to the laws of Virginia."

The land for the Reservation is located within the grant of land described in the above extract, and the greater part of it is in grant No. 269. Besides the pleasing historical connections just related, it is further interestingly linked with romantic fiction by the late Maurice Thompson in the story, "Alice of Old Vincennes." Captain Leonard Helm, who commanded the fort, Vincennes, and who is made the hero of the romance, was an officer of General Clark, who received a grant of land, some of which is contained within the Reservation tract.

The definite location of the Reservation is Monroe township, Clark county. It is twenty miles north of Jeffersonville and ninety miles south of Indianapolis, and fronts for three-fourths of a mile on the Pennsylvania railroad at the station of Henryville. The site extends west from the railroad three miles in a very regular form which is seen by referring to the map of the same.

The bill providing for the purchase of the Reservation was approved March 3, 1903. Activities were immediately begun to secure a site. By the aid of the county auditors, in such counties as possessed lands and conditions available under the law, responsible parties were secured to locate lands and take the options. In a reasonably short time thirty-two tracts were offered to the board for its consideration. The board met and deliberately considered the various offers and from their points of advantage rejected all but eleven, and so notified the bidders. These favorable sites were visited by the secretary of the board and thoroughly inspected, and of these all were rejected but three. The president and secretary of the board together with a few invited friends visited these three choice sites and thoroughly considered the merits and demerits of each from all the points of adaptability, public convenience and public influence, and ordered the contesting parties to submit map of site and secured options in writing for the final decision of the board at its meeting April 24th.

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Upon the convention of the board at that date the offer of Ramey R. Freeman and M. H. Dunlevy, of Henryville, Indiana, was accepted and a written contract entered into for the final purchase and transfer. On May 28th the completed deeds and abstracts were presented and accepted by the Attorney-General, and the owners of the seventeen farms contained in the tract were paid in full and the State took possession of the land.

THE CHARACTER AND CONDITION.

The general character of the tract will not be given full discussion here as the reports of the biological and topographical surveys will very fully cover all the details of soil, elevation and plant life. The points herein given are such as are outside of the surveys.

Aside from the historical interest which the Reservation attracts, and the sympathy of forestry interest, there are many beautiful landscape views which please all visitors to the site. The knob lands forming the western part of the tract possess views not excelled in either of the highland regions of the United States except in magnitude. There are level and rolling lands, peaks and valleys, ravines and gorges, slopes covered with vegetation and rockribbed cliffs all mingled in pleasing harmony.

The purchase of this land by the State has realized a thought which has long been fostered in the minds of the public-spirited citizens of the community. It has long been believed by them that the attractiveness so copiously displayed by nature and the opportunities for artificial enrichment would justify its being made the object of a State interest of some kind.

The general improvements on the land are very meager. The entire tract was in an unorganized state, and far the greater amount was wild waste by haphazard farming and wilful devastation of every sort. Prior to the present time the boundaries were indefinite, and in some instances not known at all. The timber land has been devastated constantly by cutting and fires. Fields were farmed without rotation or fertilizing until unproductive and then abandoned as waste land. Every possible magnificence of the tract was abused and disregarded. But the great

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majority of the people are a unit in sympathy with any movement which will advance it to its highest possibilities.

WORK ACCOMPLISHED.

Because of the unorganized condition and of the opportunities to make the site attractive and therefore inviting to the public and consequently influential in stimulating the public sentiment to the things and purposes for which it is intended, the first efforts of the board were directed toward placing the tract in a definite, organized form for operation and protection. One of the most commanding elevations, Grand View Knob, was selected for the headquarters buildings and residence of the custodian. This highland has an elevation of 1,025 feet above the sea level and 415 feet above the mainland of the Reservation. The object of the selection were the advantages for detecting and locating fires by the custodian should they occur and the climax of view afforded.

The old home which was formerly occupied by the proprietor of the "Knobs Fruit Farm" and which was located on the above knob has been remodeled and made a comfortable home. A small but sufficient barn has been erected, with other outbuildings, for the shelter of teams, feed, implements and the general convenience of the custodian. Two other residences have been preserved for homes of the permanent assistants and laborers on the Reservation. All other buildings are being removed, as they are rude huts for the most part.

Some roads have been roughly made for the necessary travel and transportation, but means has not permitted anything like satisfactory road building. The road up the knob to headquarters was a giant undertaking, but a passable one was secured around and up by a gradual ascent of less than one-inch slope to the foot by excavating on the hillside to an average depth of about eight feet and from twelve to fifteen feet wide for nearly a half of a mile. With more expense and time a very satisfactory road can be constructed up the knobs. The topographical map will show the extent of the roads thus far laid out and rudely built. There are plenty of good gravel and stone at hand to build first-class roads at a very reasonable cost if the appro-

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A VIEW SHOWING THE YOUNG FOREST GROWTH ON THE RESERVATION BEFORE CULTIVATION.

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A VIEW SHOWING THE YOUNG FOREST GROWTH ON THE RESERVATION AFTER CULTIVATION.

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priation were sufficient to carry on the general improvement and timber culture, but with the present finances the road building must be neglected.

A very satisfactory beginning was made the past summer at cultivating the young timber. The greater amount of the timber now covering the larger portion of the tract is dense coppice of both sprout and seedling growth and averaging in age from one to fifteen years. Very little of the larger timber remains and is all more or less greatly damaged by forest fires which have occurred almost annually for many years. The constant fires, the jungle from cutting timber for years and allowing the rubbish to lie, the abundant sprouting from the stumps and the rich growth of seedlings from the seeds present a task of culture which at first sight seems hopeless as far as making progress, but the contrary is the result. It is the most encouraging feature of the work. The two photographs here given show how encouraging are the results for securing a permanent forest of the best commercial hardwoods. About one hundred acres of this forest was cultivated to determine the results of the work when accomplished. All the trees unfit to remain for a permanent forest, by reason of injury or otherwise worthless as species, were cut and removed to a fuel yard. The same thing was done with all the down timber. The trees left standing and selected to form the future permanent forest were properly pruned to admit of the best trunk formation. All the litter and rubbish were leveled to the land surface and left to decay and form a leaf mold and cover to the soil as well as prevent evaporation and keep down the weeds. It was not piled into heaps as is usually done. This is always the better method to follow when a strict guard can be maintained against fire. The result of this work showed that there remained from 900 to 2,000 perfect young hardwood trees to the acre, from which, by following successive thinnings when crowding occurs, to select the permanent forest for large growth. It is very evident that such a large number of trees can not be sustained to the acre into large trees, but periodical thinnings will be made when necessary to secure the best grade of forest. All thinnings will be utilized for whatever uses suitable and from which the most can be realized. The area now in timber which

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needs this culture is about 1,400 acres. It will require several years to perform this work.

There has been very little done toward planting the cleared land to trees and seeds, because the purchase of the land was not completed till after the crops were planted and the planters reserved the right to mature and harvest them, and also because forest seeds could not be secured in time to do much planting this year. The seed crop in Indiana was very meager in yield and inferior in quality, and consequently the greater amount of the seeds secured were imported from other States, which has greatly delayed planting, besides increasing the expense of the same.

There are now stored in sand at the Reservation, for planting either this fall and winter or next spring, depending on the climate to permit soil preparation, 26 bushels of black walnuts, 10 bushels of shellbark hickory nuts, 262 pounds of American white ash seed, 4 bushels of American chestnuts, and 8 bushels of acorns. Much difficulty was encountered in securing this quantity and variety of good seeds.

PLANS AND PURPOSES.

The plans and purposes of the Forestry Station may be well understood by most persons who are interested in the work of forestry, but a complete outline of the aims may not be unnecessary for those who are not so well informed concerning them.

The plans embrace the following phases of forest cultivation, experiments and derivation:

I. Natural forests—

1. Methods and results of improvement cuttings.
2. Methods and results of reproduction cuttings.
3. Methods and results of pruning.
4. Methods and results of regeneration by seeds and seedlings.
5. Methods and results of successive thinnings.
6. Ascertaining the productive capacity per acre for trees at various ages and to maturity to determine the frequency and the extent of the successive thinnings, the age of maturity and the age of best quality of timber for the different kinds of trees; the best method, most profitable product and the right season to harvest the trees at different stages of growth.

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II. Cleared fields—

1. Methods and results of soil preparation.
2. Methods and results of planting with seeds.
3. Methods and results of planting with seedlings.
4. Ascertaining the best distances at which to plant the different trees to secure the best results; the results of mixed and pure plantings from both seeds and seedlings; the required culture to the stage of survival and to the stage of natural forest attention as given under "I" above.

III. Nursery for the supply of seeds and seedlings to planters within the State upon application and for agreed purposes of forestry—

1. Methods of gathering seeds and treatment for planting.
2. Methods of broadcast and row planting of seed in nurseries for seedlings.
3. Methods of and serial transplantings and prunings of seedlings for ornamental trees of large size.
4. Open long-distance plantings of the different species of trees for seed orchards, and to determine shade-tree culture and selection.

IV. Scientific—

1. Tree diseases, causes and remedies.
2. Insecta, life history and remedies.
3. Temperature and moisture observations.

The first three divisions of the outline will be given the emphasis of first attention, as they cover the points which the patronage of the office has indicated that it desires information concerning. They are also the things which the board feels should be first demonstrated and the correct knowledge derived for the public benefit. Time, circumstances and investigation will naturally suggest other points or may modify the present plans, but the present aim is to execute closely the above course. The reservation tract will be plotted to carry forward the various phases of the above outline, and all operations and results will be recorded and reported together with the topographical conditions directly connected.

It must be very apparent to all that years of time, patience, work and much expense will be required to perfect the plans

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herein given. But when it is recalled what a great factor the past abundant timber supply has been to the prosperous, industrial condition of the State, and what it will mean when the supply is exhausted, no effort can be too great to perpetuate the forests. Surely no greater problem of industrial supply confronts the American industries. Indiana by nature is a tree-growing State. Every condition is favorable to successful forestry. The people have but to know the right processes, do them, have patience and be rewarded either themselves or their generations.

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REPORT OF TOPOGRAPHICAL SURVEY.

The survey of the Indiana State Forest Reservation was made by Sophomore and Junior students from the Civil Engineering Department of Purdue University. The party consisted of six assistants—A. D. Faulkner, W. L. Harrison, Manual Rivera, W. J. Ryan, C. E. Shearer and E. G. Sevendsen, in charge of R. V. Brewster. They were assisted by Ramey R. Freeman, of Henryville, Indiana.

The equipment, consisting of two transits, two levels, hand levels, tapes and many smaller instruments, was loaned by the Civil Engineering Department of Purdue.

The northern half of the Reservation lies in the sections and the southern half lies in the Illinois Grants, which were given to the soldiers of General George Rogers Clark. The western, and part of the northern boundary is on the line between Scott and Clark counties. The knob region lies entirely in the northern part, and is practically all heavily timbered. Several peaks have an elevation of over 1,000 feet above the sea level. The larger creeks lie in the southern part and none of them run freely except in the spring and rainy seasons.

The entire survey covered a period of nine weeks. The survey of the boundary began June 15th, 1903, and was finished July 8th. The time in making this survey was greatly lengthened by the rough land and the heavy undergrowth. Along the northern and western boundaries in the knob region, the hills were very steep, and much of the distance was measured by means of broken chain. Many settings of the instrument were required. The perimeter of the tract is nine and one-half miles, most of which is through dense undergrowth.

While making the survey of the boundary, a complete set of notes was kept of the topographical conditions, in addition to the traverse notes. The lines were run with a complete engineer's transit and the distances measured with a one hundred-foot steel tape.

The topographical survey began July 9th and was completed August 15th. The elevations were taken from the sea level bench

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marks of the P., C., C. & St. L. R. R. Levels were run around the boundary, and bench marks were established at regular intervals. The northern grant line of the Illinois Grants was taken as a base line from which the survey was started. Stakes were set at intervals of six hundred feet and elevations determined. Perpendicular lines were run from these base line stakes and the distances measured by means of the transit and stadia. These elevations were checked by the bench marks along the boundary.

The topography party followed the transit party, and a complete set of notes and sketches were made in the field. The topography between the transit lines and along the hill sides was taken with hand levels.

Field sketches, showing the roads, contours, creeks, timber and cleared lands were drawn at a scale of one hundred feet to the inch. The roads, ridges, and creeks were traversed and elevations carried along them.

The final map showing the boundary and topography was reduced from the field notes and sketches to a scale of four hundred feet to the inch.

ROGER V. BREWSTER,
Chief of Survey.

December 5, 1903.

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E. G. SEVENDSEN, A. O. FAULKNER, W. J. RYAN, R. V. BREWSTER, W. L. HARRISON, M. RIVERA, C. E. SHEARER AND C. PIPER SMITH.

Purdue students of the Civil Engineering Department, who made the topographical survey and map, and C. Piper Smith of the Science Department, who made the botanical survey and map of Indiana Forest Reservation and Station of Forestry Demonstration.

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THE FARM FOREST.

There is at the present time a strong sentiment and demand by farmers, and other timber-land owners, for information and instruction of a common-sense, practical kind which will enable and guide them in conducting forestry work for themselves. They do not want to resort to expert foresters, but desire such advice as will direct them to perform their own forestry work in the most simple and effective manner. It is not to be understood, however, that expert forestry is not needed, or is not a good thing, but that there are conditions where it is not needed and is not sought or desired. There are landowners who have a good knowledge of the nature, the habits and the uses of trees and intend cultivating their farm forests or wood lots without employing others to do it. There is a judgment being formed in favor of perpetuating the timber areas after cutting a crop instead of clearing the land and putting it under agriculture. It is instruction for this kind of forestry work that the following discussions are intended.

PRESENT FOREST CONDITIONS.

The greater amount of the timber now growing in the State is second-growth hardwoods, either by sprouting from the stumps of the preceding trees which have been cut off, or by springing from seeds in the forest mold upon sunlight and air being admitted. The forms of the present forests are either wood lots or abandoned fields growing up and alternated by cleared fields, and will therefore, require more careful cultivation because of the climatic exposures.

The sprout forests are inferior to those growing from the seeds, and less valuable trees may be expected from them. The reason for this is that the stumps from which the sprouts grow become decayed and, therefore, affects the tree growing from it. It is to this cause that many of the decayed and hollow trees, especially at the butt, can be attributed. It is to this same cause that many of the trees die at an early age, become affected with disease, and are eaten by beetles and borers more than other trees in the same

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locality. Each succeeding sprout growth will reveal more of these defects, because as the stumps decay more and are repeated they become weaker in vitality. It therefore stands the owner of a forest well in hand to anticipate these evils in the perpetuation of his farm forest by seeding it in conjunction with sprout cultivation.

In very old sprout woods it has been ascertained that the rate of annual decay often exceeds the annual increment, and as time elapses they become more ragged and open. It has been distinctly discerned that trees growing from stumps which were cut high and ragged are more defective than those growing from stumps cut low and smooth. The reasons for this are at once visible to the mind. Stumps cut high and ragged afford first, a chance for the sprouts to come out far above the ground and thus leave less chance to establish a root hold in the soil, and are, therefore, wholly dependent on the stump for nourishment; and, second, the ragged form of the stump affords greater opportunities for decay and thus destroys the chances of life to the tree growing from it. Stumps cut low and smooth obviate these difficulties and enhance the productiveness and promote the chances for permanent growth.

There are three phases of treatment which may be considered as the right things to apply to make the farm forest tracts successful. They are known as improvement cuttings, reproduction cuttings, and restocking with either seeds or seedlings. The following points will prove to be the right things to emphasize in applying treatment that the best results may be obtained.

1. Proper cutting of the stumps in removing trees to insure the right conditions for sprouting and nourishment.

2. Careful thinning of the sprout and seedling growths to obtain the strongest, best trees for the permanent stand.

3. Right pruning of the trees selected to stand, in order to form correct boles.

4. Restock the scanty parts and the portions possessing undesirable trees with seeds or seedlings of the right kinds.

5. Protect the forest from injury by fire, grazing and ruthless destruction in cutting trees when removing them for use.

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CUTTING FOR IMPROVEMENT.

Improvement cuttings mean the removal of such trees as are the least promising, most unlikely and undesirable, and such as hinder the right development of the best trees desired for the permanent stand. The thinning out to a proper number to afford the right chances of growing to the selected trees intended to form the forest. It does not have in it the idea of a new growth, but simply the improvement of the existing stand of trees.

In the performance of this work judgment must be exercised not to cut out too much. A sufficient number should be retained to protect the soil from the sun and wind, which, if permitted too direct contact, will dry it out and hinder the trees from growing because of the lack of moisture, extravagant branching and the springing up of weeds and grass to sap the substance from the trees. The growth of weeds and grass and the lack of moisture will also prevent young trees which might spring up from the seeds from doing any good to form the succeeding crop when the older trees are cut off. A good rule to follow in this would be to, first, remove the dead and dying trees; and, second, such stunted medium and undesirable kinds as is necessary to the end sought. This plan will surely bear the stamp of utility, as the cutting out of the dead and dying trees will enable them to be used instead of remaining to decay and afford chances for a forest fire. Their removal heightens the advantages of growing to the standing trees. In some instances of wood lots which have never been thinned it will be found necessary to cut out the overtopping trees, as the young, healthy trees springing up beneath and hampered by their shade demand and justify release from their crowns. The individuals should give way to the many. Very frequently the cutting of those dominant trees gives the best results, as the young trees which they suppressed respond quickly to the conditions of light and soon fill the space made vacant.

There are two phases of improvement cuttings, the even and the uneven. The former has reference to cutting out all the trees down to a uniform size and repeating at periods of years (as every 15, 20, 30, or 40 years), depending on the wishes of the owner and the size of timber wanted. In most instances the time of repetition is about 20 years. The latter idea has reference

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to no uniformity of size or period of years, but the cuttings are made at any stage of growth when material is desired and the conditions demand that cultivation be instituted. The latter plan is such as will be found preferable for farm forests where there are annual demands made on the timber for economic uses. The owner in selecting trees to cut for his purposes will study his forest and make his selection with the view of improving it instead of haphazard careless cutting anything and anywhere.

CUTTINGS FOR REPRODUCTION.

Cutting for reproduction is the process of forest cultivation whereby a new stand of trees is sought to replace the ones removed. Trees are selected and cut at different places over the forest to suit the idea of the party who is reproducing it, and are cut in such a manner and with the thought that either a growth of sprouts or seedlings will put up, or both may be in contemplation. Such forest cultivation is not calculated to produce the required forest, but is the initial to it. A forest obtained by this method, unaided, is uneven and irregular in almost every feature and must be followed through by the improvement cutting process to result in a finally valuable forest. Every principle of it will reveal this. The best trees are removed to cause the reproduction and the poor undesired kinds left, which must be gotten out of the way by the latter process. A reproduction forest pure and simple is inferior.

It is therefore evident that these two distinct processes of forest culture must be co-ordinated to secure the final successful aim, and the points 1 to 5 previously enumerated are the essentials for emphasis.

CORRECT STUMP CUTTING.

The stumps should be cut as close to the ground as possible, that the sprouting will not occur too far above the ground and thus lessen the chances of the sprouts to establish a hold in the soil for nourishment. They should also be cut smooth and slanting, to allow the water to run off, instead of remaining to soak into and rot the stump, thereby affecting the chances of sprout-growth and their thrifty condition. The bark should not be torn and split from the stump, because such will lessen the opportunities for

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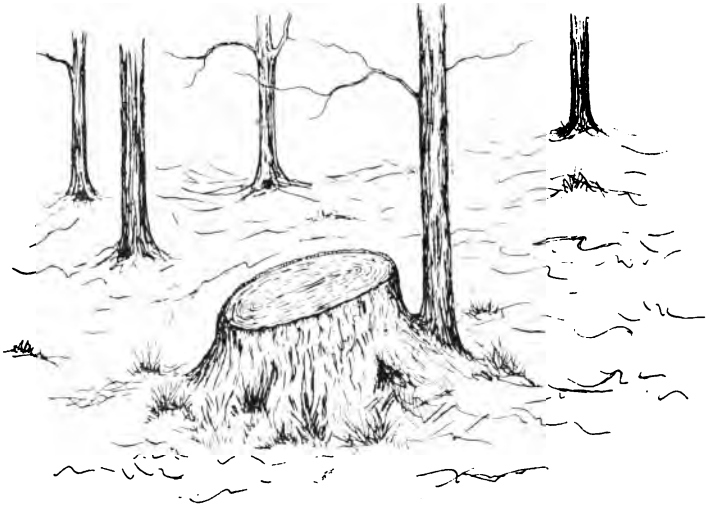
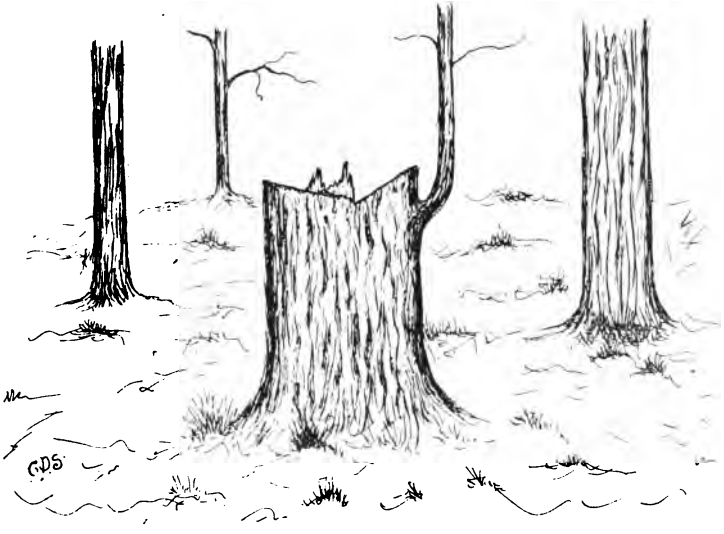


A Properly Cut Stump.



An Improperly Cut Stump.

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buds to form and thereby sprouts; besides, the conditions for decay are heightened.

There are two seasons considered as the right times to cut trees to secure the best sprout growth. They are the season of down sap and the season of sap flow. The time of the former is from October to February in this climate and the latter is from February to June. These limits are the maximum. It is not at all advisable to cut in summer as the sprouts which may then put out are tender and immature for the winter and the freezing so affects them that they usually die the following season, or if they continue to live they are more or less inferior because of the damage resulting from the winter on account of their tenderness. As to which of the two favorable seasons is the better I am not sufficiently informed to dictate; however, the following points will help owners to decide for themselves. The stumps cut during the sap flow season sprout surer and more numerously than those cut in the down sap season, but the abundance of the sprouts is detrimental because it requires more work and expense to thin them and the sprouts are weaker because of the number. The stumps decay sooner when cut in sap-flow, and thus affects the permanent growth from them. The farmer finds his time occupied more with other duties in the sap-flow season, and will therefore not be able to devote such careful attention to the correct cutting.

The down-sap cutting fails in some instances to sprout, but the less abundance is very favorable, because less labor and expense is required in thinning and the sprouts are stronger and will mature better for the winter. The stumps season better against decay and consequently insure a stronger permanent growth to the forest. The farmer can also devote more care to the correct cutting, as at this time of the year the duties of the farm demand less of his attention.

In selecting trees to cut with the view of establishing a sprout forest it will be well to consider that old trees which are mature will not do any good at sprouting. The best results are obtained from trees from twenty to forty years old and in the best vital condition.

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FOUR CHESTNUT SPROUTS SPRINGING FROM A FOUNG, VIGOROUS STUMP OF FIVE INCHES IN DIAMETER.

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SPROUTS GROWING FROM AN OLD DECAYED STUMP AND WHICH ARE LESS VIGOROUS THAN FROM THE SMALLER STUMPS OF YOUNG THRIVING TREES.

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THINNING PROCESS.

This topic has been slightly mentioned under the topic, "Cutting for Improvement," but will be treated more fully. When the reproduction cuttings have been performed and the growth of the new forest is well established, thinning will become necessary, and the owner, to cultivate it, will want a definite plan of operation in mind. The following will be found a good course to follow:

1. Remove all the dead and dying trees.

2. Cut out defective trees, those possessing frog stools, canker, scars, hollows, girdles by fire and otherwise, or top dry, eaten by borers, bent and broken by snow, sleet or storms.

3. Take out those that are suppressed beyond recovery, those crowding the more thrifty ones and the large crowned trees that are holding back a strong undergrowth of seedlings, which if given their freedom would soon spring into valuable timber trees.

All of these classes of trees will, for fuel and other common uses, yield a value, if judiciously handled, commensurate with the labor and the investment, besides the satisfaction of carrying forward a systematic, altruistic, aesthetic and valuable work.

When this thinning process has been well executed the stand of trees retained will be of the best quality and the proper quantity for the forest, and the cultivation for its future development will be only the cutting out which becomes necessary to retain it in prime condition. If the stand is thick, a few years growing will require a second thinning which may call for the same or a different plan of operation from the first, of which the owner, if thoroughly in sympathy with retaining his wood lot, will ascertain for himself. For most of the ordinary farm forests the annual demands for fuel and timber for other uses of the farm will cause enough cuttings, if rightly applied, to properly develop the forest to the best stage of value and usefulness, which will be in time from forty to fifty years for large valuable timber. A complete harvest can then be made and the forest again renewed. Mill owners assert that a crop of good saw timber can be cut about every twenty years if the young forest is left to grow after a crop has been cut off. This is asserted by many owners and observers of tracts which were thoroughly cut off for saw timber and per-

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mitted to grow up again without cultivation. If proper culture had been given them the results might have been many fold more of value.

PRUNING FOREST TREES.

Pruning forests is not always right, but when it is done at an early stage of growth it is practicable. It will very materially aid to the best trunk formation. It is found to produce the best results if applied when the trees are from twelve to fifteen years old and is not too heavily done. The limbs should be cut off smoothly and as closely to the body of the tree as it can be done not to tear or disturb the bark on the body. The limbs are removed as high up as the woodman can execute the work well with an ax or pruning knife. When the pruning is performed in this manner the cuts soon heal over and no blemish is formed to injure the wood value when the tree is cut for saw timber. If the limbs are cut off a short distance from the body, the snag left dies and rots down into the body of the tree and forms a permanent blemish to the wood.

The best time to prune is from the last of June to the first of February. The sap will not exude from the cuts to attract insects, sprouts will not form at the junctures and the wood does not rot at the cut. If the pruning is done at the season of greater sap flow all the above points are reversed. This topic will be better explained under the report of the work done in timber culture on the State Forest Reservation the past year.

RESTOCKING WITH SEED AND SEEDLINGS.

In a vast majority of wood lots there are patches, and in some instances the whole lot, where the stand of trees is scanty and most of the species are undesirable and consequently neither of the processes heretofore described would be resorted to for renewal. Restocking them with seeds and seedlings of the best kinds is the only method of renewing them to make them valuable. The few trees remaining, however, by the shelter of their crowns will aid materially in the restocking. In the wood lots of this type, there may be made, for discussion, two divisions, the extreme and the medium forms.

The extreme wood lot is one in which no trees of value remain to aid in the restocking process more than the shelter afforded by

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their crowns. The kinds and conditions are such that they would not do for seed trees to be used as nuclei from which to restock.

In addition to the above conditions a sod has formed over the area, and let it be understood that sod and forest can not exist at the same time and in the same place to any successful degree of either. If the owner desires to renew a wood lot of this type, the sod must be thoroughly broken up the spring or fall previous to restocking and allowed to decay and form a well pulverized surface to receive the seedlings. The "strip" plan can be used in this process. A part of the lot can be prepared and planted each year until the entire area has been gone over. The seeds may be gathered at any season in which they mature (see discussion of seeds) and can be planted at once on the pulverized soil either in rows or broadcast, or they may be stored till spring and then planted.

The distances for planting trees to secure the best results have not been determined, but the recognized ones are four to eight feet apart each way for row planting, so that cross cultivation can be performed. Broadcast planting will not bear such close distances and the success can not be so assured.

The medium wood lot is one which possesses some good forest, but there are patches of scanty trees with sod formed alternating more or less over it. In many instances the trees remaining on the thinned places are of a good kind and can be used as seed trees from which to restock, and then removed to let the undergrowth advance unhampered. The "group" system can be used to restock in such lots. By this system the good trees are used as nuclei for restocking. The sod is broken as before described and the seeds are permitted to fall and become imbedded in the pulverized soil to spring forth as nature brings them. Effort may be made to extend the seeds as far from the trees as the quantity will permit, to secure a stand, or the seeds may be permitted to germinate in a mass under the tree and then be transplanted to other areas at a distance. There is seldom a year that such trees do not bear seed, but the sod formed under them prevents the seed from getting a germinating hold in the soil, or stock is permitted to eat them and thus destroy the chances of a new growth of trees naturally.

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PROTECTION OF FORESTS.

Forests are the least protected against damage of any other form of property the owner possesses. Every year there occur in Indiana forest fires in great number. There is not a county in the State that is not the scene of annual forest destruction by fire. The sources of fires are locomotives, careless hunters and neglected brush fires from clearings. In almost every instance the damage is far greater than estimated, if any thought is given to calculating the loss. In most cases no thought is given to the damage and but little effort is made to check the fire unless it promises to extend to other property. The only seeming effort made is to confine it to the forest area and let it burn itself out. If an actual estimate were made of the damage accruing from a medium forest fire it would astonish the owner and reveal to him that the loss of his crops and buildings would not exceed it, and yet he willingly permits it to burn unmolested in his timber and frequently gazes upon it with a pleased mein wholly unconscious of its damaging significance.

The injury done by a forest fire can not be estimated by the value of the trees that die directly, but the injury which is sustained by many that live on after the fire is such that they are made valueless. The fire burning for only a short time in the leaves and humus causes sap boiling wherever the heat comes to any extent in contact with the tree and in a short time the bark dies, falls off and the wood is exposed to die and form a rotten place in which borers and beetles form their attacks upon it. In after years when the tree is cut it is found to be hollow, worm-eaten and generally affected, rendering it of no consequence except for fuel. It is seldom that a sound forest tree is now found, which fact may be traceable to past forest fires. It is sincerely urged that all who are interested in the saving and the promotion of the forests will lend their efforts to guard against forest fires and to enforce the laws against all violations.

Wood lots surrounded by cleared land can easily be protected. If fire should by chance start in them it can promptly be seen and put out. If the forest is subject to danger from fires by its proximity to railroads or similar causes fire lines can be established and retained easily to prevent the fire from spreading

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A VIEW OF YOUNG FOREST DEVASTATION BY FIRE WHICH OCCURRED A YEAR AGO THIS LAST SUMMER ON THE NEW FOREST RESERVATION.

It is estimated that 50,000 young trees were absolutely killed by this negligent fire.

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A SUGAR MAPLE SHOWING THE PERMANENT INJURY FROM FIRE BURNING THROUGH THE LEAVES AND CAUSING SAP BOILING AND THE ATTEMPT TO HEAL OVER.

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beyond the limit. Strips on the danger points can be cleared of leaves, and rubbish, which will prevent progress. Regular lines may be made for such purposes and kept plowed up during the danger season. In case fire breaks out and no fire lines exist to check it, the thing to do is to make such lines at once and in such places as will check the fire from spreading. If no water is available to put out the fire, fresh dirt thrown into it will readily put it out. Back firing can be done to head off a fire where the means described can not be used. Judgment will reveal many simple ways to stop a forest fire without letting it burn itself out.

Young trees should be protected against stock, which browse upon them, gnaw the bark from the trunks, bend, break down, and otherwise destroy them. A forest can not be successfully renewed if stock is permitted to pasture therein until the stand is above their harm.

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A VIEW OF FIRE INJURY BY BURNING BRUSH IN A FOREST, A THING WHICH SHOULD NEVER BE PERMITTED.

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A VIEW OF THE INJURY OCCURRING TO A YOUNG POPLAR BY FIRE BURNING THROUGH THE FOREST LEAVES AND CAUSING SAP BOILING.

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SOME TREES TO PLANT FOR RAILROAD TIES, FENCE POSTS AND LINE CONSTRUCTION POLES.

The kinds of timber which have been almost exclusively used for these purposes is rapidly becoming exhausted, and an effort must be made to meet the future demands by growing them under cultivation. Farmers are finding difficulty in securing good fence-posts at reasonable prices, railroad companies are resorting to inferior grades of timber and treating them chemically to supply them with crossties, and line construction companies are compelled to pay fancy prices for poles used in telephone and telegraph line building, and every sign indicates that the demand will be larger as years pass. Farmers can meet these demands at good profit by cultivating a part of their land to timbers suited for these uses.

The trees given here are some of the best for these uses and are all rapid growers.

CHESTNUT.

The natural range of the chestnut is from southern Maine to the Gulf of Mexico. It thrives well throughout the Mississippi Valley.

The soil best suited for the growth of the chestnut is retentive clay containing some sand or at least porous. It does not demand a rich soil and does excellently on old, abandoned fields. The chestnut will endure the heat and cold of the temperate climate and will grow very well in sunny, dry situations.

The wood of the chestnut is light, strong, coarse-grained and inflexible. It splits very readily and is exceedingly durable in contact with the soil. It is used in cabinetmaking and for interior finish. In all sections of the country it is prized very highly for use as railroad ties and telegraph poles. It makes very durable posts, and is also valuable for shingles. Its rapid growth and tendency to reproduce by coppice make it a valuable tree for these uses. The chestnut grows very rapidly on good situations. The trunk of the tree grows tall, tapering, and free from limbs.

The chestnut reproduces from seed and from sprouting from the stumps after cutting off. The growth from stumps with good

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root systems is very rapid, and cuttings can be made about every twelve years. The seeds ripen at the time indicated in a preceding article and they may be planted as soon as mature or may be stored and planted in the spring. It can be grown well from seedlings, as they bear transplanting successfully. The best distances to plant are 4x4 feet or 6x3 feet.

I consider this one of the finest trees for farmers to plant, because of its clean nature, lasting qualities for all the uses given and its ease of cultivation. The trees should be pruned when young to form the correct boles.

CATALPA.

The Catalpa Speciosa occurs naturally on the deep, fertile soils of the valleys of southern Indiana, Illinois, western Kentucky, Tennessee, southeastern Missouri, northern Mississippi, Louisiana and northeastern Texas. In the most favored localities it attains a height of from 60 to 80 feet, occasionally reaching 100 feet. The diameters range from 2 to 4 feet. This has proven to be a valuable tree, hence at the present time has become exhausted along with the other valuable kinds, so that now it is rare that a fine tree can be found. It is capable of a much more extended range than is given it. It has been successfully propagated as far north as 41 latitude and as far west as 100 longitude. I do not believe that there is another tree capable of stronger soil adaptation than the catalpa. It is especially adaptable to deep, fertile, porous soils, and thrives well when there is an underflow of water within 10 or 12 feet of the surface, even in slight rainfall. Because of these attributes it is successful throughout Indiana, with the exceptions of the stiff, clay soils, and a mistake will be made if it is planted on such soils, no matter how much attention and care may be given it.

The catalpa is a rapidly growing tree, when congenially located, for a period of 50 years and more. From 15 to 25 years are required to grow trees suitable in size for telegraph poles and railroad cross-ties, while for fence posts from 8 to 12 years are required. Plantations favorably located have returned great profit. Some of the following are instances of the returns: The George M. Munger plantation, Eureka, Kansas, averaged at 13 years a net

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annual profit per acre of $15.01; the H. H. Hunnewell plantation, Crawford County, Kansas, averaged at 18 years a net profit per acre of $26.47; the L. W. Yaggy plantation, Hutchinson, Kansas, averaged at 12 years a net annual profit per acre of $21.55. In all these instances the stock for planting was purchased, the planting was cultivated for two years and paid for. Every expense, including 6 per cent. interest on the investment was counted and deducted from the gross earnings.

It is most readily propagated from seed sown in the nursery in the early spring. The seed can be easily obtained from seedsmen. They ripen in October and can be gathered and safely kept through the winter in a cool, dry place. The nursery site should be of rich, mellow soil finely pulverized. The nursery rows should be for hand cultivation, 18 inches apart, but for horse cultivation they should be 3 feet apart. If the proper attention is given the nursery, the seedlings will be sufficient size for planting the following spring. Owing to the fact that it is difficult to grow the catalpa with straight boles, extra caution must be taken to force the right form of trunk. It should be planted at distances of 4 by 4 feet or 6 by 3 feet, and not to exceed 5 by 5 feet under the most favorable conditions. The tendency of the catalpa seems to be to branch and crook in growing. If it is planted closely, the lateral branches die before they attain any size and are easily pushed off without causing any damage, but otherwise they remain and cause permanent damage to the body of the tree. New wood is formed around the branch and thus leaves a hole into which water is conducted and the tree becomes affected by rot in the heartwood. In addition the close planting causes them to grow up in search of light and thus checks the tendency to crook. The difficulty to straight trunks is the serious drawback to the catalpa. The surest method for overcoming this evil is to cut the trees back to the ground at the end of two or three seasons' growth. The extensive root system formed will cause vigorous sprouts to put up from the stump. In midsummer following the cutting back, they should all be removed but the one most thrifty, which if left is soon forced upward in a long straight bole, free from the numerous branching. At the end of the same time a great advantage is gained by doing this, though it may appear like destroying the two or three years'

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A FIVE YEAR OLD CATALPA FOREST AT BRIGHTWOOD, INDIANA.

Showing the trunk forms when not cut back for sprouting. These trees were planted at too great distances, eight and ten feet.

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THE FIVE YEAR OLD CATALPA FOREST AT BRIGHTWOOD, INDIANA.

Showing the sprout formed at the end of the first season's growth after being cut back to the gronnd.

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growth. It can be grown successfully in pure or mixed plantings with the walnut, locust, ash or Kentucky coffee tree. In case planters do not care to grow seedlings for planting, there are nurseries throughout the West which grow them for wholesale plantings at very small cost per thousand.

There is difficulty in planting the catalpa by not being able to distinguish the varieties. There are at least four different species, two being shrubs and two fully developed trees. The Warder Speciosa or hardy catalpa can be distinguished as follows: The leaves are from 5 to 12 inches long, heart shaped, long pointed; the flowers are about 2 inches long, nearly white, faintly spotted, the lower lobes somewhat notched; the bark is rough and thick. The other species (Catalpa Bignonioides) which is also a large tree, has about the same shaped leaf, but has scaly glands in the axils of the large veins on the under side, entire, usually, angulated, opposite and sometimes in groups of threes, very downy beneath when young; the flowers are much spotted with yellow and purple and with the lower lobe entire; the pod is long and thin; the bark is lighter in color and not so rough and is thin. The other kinds are mere shrubs and at no time could be mistaken for the larger kinds. The former one is the tree to plant for economic uses, though the other kind will give fair returns in durability.

There are two forms of disease which infect the catalpa, the wood rot and the leaf blight. The wood rot may be classed into kinds, the soft and the brown rots. Both are caused by the decay of limbs which are left on the tree till growth takes place around them thereby leaving holes into which water is conducted as heretofore mentioned. The remedy is to prevent any such conditions by pruning and daubing over the cuts so that fungi spores can not get in to form such rot. Right planting, pruning and treatment by daubing the cuts made will avoid such difficulties. The blight of the leaves is due to the larvæ of Diplosis, a gall-gnat. The affection is evident by the leaves, shoots and buds turning black, shriveling and dying. Trees which are affected several years in succession show the effects by the numerous sprouting of limbs and trunks. No good remedy is known at present.

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KENTUCKY COFFEE TREE.

(Gymnocladus dioicus.)

The natural range of the Kentucky coffee tree is the northern two-thirds of the Mississippi Valley. This is one of the rarest trees of North American forests. Its range for economic planting is coincident with its natural range. It should be planted much more frequently in the future than in the past. In barren soil, it is a slow-growing, long-lived tree. In fertile river valleys it grows more rapidly. It produces the best results on the richest bottom lands, but will thrive on sandy or gravelly uplands. This tree will endure the most extremes of climate.

The wood is heavy, moderately hard, coarse-grained, strong, and very durable in contact with the soil. The sapwood is thin and the heartwood of a rich, reddish-brown color, is very suitable for cabinet work and interior finish. The timber is but little known at present.

The Kentucky coffee tree sometimes attains a height of 100 feet and a diameter of 3 feet, but it is usually much smaller. The trunk usually possesses a very uniform thickness and is tall and free from limbs.

This tree reproduces from seeds which are borne in pods by the pistillate individuals in great abundance. In starting a forest plantation of this species, it is much better to plant the seeds in nursery rows and transplant the trees into the final forest site at the end of one year than to attempt to grow the trees from seeds planted in the permanent site. The Kentucky coffee tree develops a root system which adapts it to transplanting.

The pods should be collected in the late fall and macerated in water to remove the seeds. After the seeds have been separated from the pods and dried reasonably, should be stored in sand to weather.

The rules for planting the coffee tree are the same as for the locust and chestnut.

The Kentucky coffee tree is a light-demanding species. It can not keep the grasses and weeds in subjection when planted alone, owing to the open nature of the foliage and to its habit of leafing out very late in the spring. In nature it grows associated with the ash, walnut, hickory and elm. When making a forest plantation

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of this species it should be mixed with such trees as the white elm, red elm, hackberry, oaks and ashes. If planted several years previous to its associates, it may be mixed with hardy catalpa, Russian mulberry or black locust. The growth and habits of this tree in the Southwest are very similar to those of the walnut. It can be substituted for the walnut in almost any planting or use.

BLACK LOCUST.

The black locust was originally indigenous in the mountainous regions from Pennsylvania to Georgia, and occasionally Arkansas and eastern Indian Territory. But at the present time, through cultivation and other agencies, it has become naturalized throughout the United States east of the Rocky Mountains. It is appearing naturally abundant upon abandoned hillsides in the states of Pennsylvania, Ohio, Indiana, Kentucky and in the southern portion of the plains west of the Mississippi to the mountain slopes. It is associated with other deciduous trees in the form of small scattered groves.

There is an objection offered against the black locust on account of its sprouting and spreading tendencies from the root. I do not consider this a sufficient cause to militate against the planting of this tree for economic purposes. A casual observation will convince that most any tree does equally as bad, but nevertheless caution should be taken to confine it where planted. The seeds should not be allowed to become scattered over the farm by being hauled out in the manure or otherwise. A row of osage, soft maples or other dense shading trees planted around the locust planting will prevent spreading.

The growth of this tree is very rapid in all rich, loose soils. It attains its maturity at about 50 years and the usual size is about 80 feet in height and from 2 to 3 feet in diameter, depending largely on the distances planted as to its trunk formation. The largest and quickest matured specimens are found in deep, loose clay, valley and bottom-land soils, though it grows successfully on poor soils if sandy or gravelly, and it is shown to be the most durable wood when grown on such lands. The locust should never be planted in hard, wet, clay soils as its roots are surface spreading and draw nourishment from the surface and hence in such soils can not penetrate sufficiently to insure a good strong growth.

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The black locust is finding extensive use for posts, ties, telegraph poles and vehicle manufacture. Its great durability in contact with the soil, its toughness and elasticity of fiber make it valuable for these uses. A post from 6 to 8 inches in diameter can be grown in from 10 to 12 years in good soil. Unlike many other timbers, the young wood is almost as durable as the old. Posts of such character last from 12 to 20 years, though extremists say much longer. This tree is a most valuable one for fuel planting.

The planting, to secure good results, should be close, 4 by 4 feet or 3 by 6 feet. They should be pruned when young to aid in forming, straight, long boles. Every effort should be made to keep the trees thrifty and growing, to prevent attacks from borers. To this end the grass and weeds should be kept out till the growth is large enough to protect itself. The planting should be watched to make trimmings at the proper times to prevent the decay and injury by crowding and smothering. A thrifty growth is seldom attacked by borers. The locust grows well in mixture with the catalpa, elm, ash and walnut.

The black locust is propagated from seeds and root cuttings. The seeds retain vitality for years if kept in the pods or buried deep in the ground, 7 years having been known to find good vitality remaining. The seeds ripen in July and August and may be planted at once or kept in storage till spring and then sown in nursery rows. The seedlings should be propagated in the nursery bed and transplanted to the permanent places in the plantation the following fall or spring. If the nursery is to be cultivated by hand the rows should be from 15 to 18 inches apart, but if by horse cultivation the rows should be 3½ to 4 feet apart. A pound of seed contains about 2,800 in number and is sufficient for a row of nursery 900 feet long. The nursery site should be in rich, pulverized loam. To secure the best degree of seed germination the same year they are planted they should be treated to soften the stone shell of the seeds. The seed should be removed from the pods and kept stored by placing in boxes, stratified in layers of sand, kept moist during the winter until time to plant. They may be placed in a box or bag and buried in the ground so that water will not settle upon them, and let them remain until time to plant in the spring. Freezing and thawing will add benefit to the result.

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FOUR YEAR OLD BLACK LOCUST FOREST OF ROBERT MAXWELL, MARTINSVILLE, INDIANA.

These trees were planted on a rolling porous, sandy clay slope at distances of six feet apart and were never cultivated except pruning the past summer.

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Nursery-grown seedlings can be secured at very low cost per thousand from reliable firms engaged in growing forest tree stock for wholesale planting. Any seed firm can secure the seed for its patrons.

I do not anticipate that there are many who do not distinguish the black from the honey locust, but I have frequent enquiry concerning the differences of these two trees. In short the characteristic differences by which they may be known are as follows: The black locust has reddish-brown, rough bark, broken in ridges; the leaves are compound, alternate, rounded at both ends, entire netted-veined, occasionally tipped with the end of the midrib and covered with silvery short hairs when young; the flowers are white, fragrant, and in loose axillary racemes; the seedpods are linear, smooth, short, contain from 4 to 6 brown seeds and hang on the tree over the winter. The honey locust has rough, gray bark broken into scales at the base of the trunk; the young branchlets are a deep reddish-brown; the leaves are compound, alternate with long, downy leaf stalk, smooth, green above, yellow below and from ten to twenty long oblong leaflets tapering towards the apex and rounded at the base; the flowers are greenish white and grow in narrow racemes; the seed pods are from 9 to 20 inches long, reddish-brown, flat, linear, curved, contain between the seeds a sweet substance and seldom hang on the tree during the winter.

The honey locust is usually very thorny, while such is seldom the case with the black locust.

OSAGE ORANGE.

The osage orange thrives well throughout the same range as the chestnut, though it has been more widely introduced by cultivation. The soil best suited to its growth is deep, rich, clay loam, retentive of moisture.

It has been extensively planted for hedge throughout the Central States, but it should be more frequently planted as a timber tree. It sometimes gets winter killed in the northern part of this State.

The growth of the osage for the first few years is very rapid. It never makes a large tree, and matures in a reasonable period of time. The tree when standing alone has a tendency to branch very profusely. It is this habit which renders it of such great

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value as a hedge plant. If crowded, it can be made to grow into a form which adapts it for posts. The osage orange reproduces by sprouting from the stumps, from the roots and from seeds, which are borne in great abundance by the pistillate individuals. The ripe fruit containing the seed is a fleshy, globular, yellow mass with roughened surface, somewhat resembling an orange. The fruit should be collected in the fall as soon as ripe, macerated and the seeds washed out and stored in sand. Seedlings of this tree can be bought cheaper than any other kinds from nursery firms.

A good method of planting the seed is in the bottom of a furrow made by a plow. They should be covered about an inch and a half deep. The seeds may be planted where the trees are intended to stand, or they may be planted in a nursery and the trees transplanted to their final site at the end of one year. The right distances of planting are same as the chestnut.

The osage orange reproduces from coppice very readily. This quality allows the planter to continue to take successive crops of posts from the same plantation for years. The young shoots grow up from the stump with such vigor that the second crop is more likely to consist of straight, smooth post timber than the first crop.

The osage orange is a shade enduring tree. The thorns of the tree make it often undesirable to plant. The osage orange does well in either pure or mixed plantations. In this way thick planting may be practiced and the need of inner tillage reduced to a minimum.

BLACK WALNUT.

The range of the black walnut is west from Massachusetts to Kansas and south to Florida and Texas, covering practically the middle Atlantic, Central, Southern and a portion of the New England States. It was formerly abundant throughout this range, and is undoubtedly a sure tree for economic and commercial plantings in the Mississippi Valley from Minnesota southward. The soil best adapted to the growth of the walnut is fertile alluvium containing large quantities of humus. It thrives best in porous, open subsoil, such as is found in low river bottoms. The walnut is subject to injury by exposure to hot winds and extreme cold,

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therefore, some judgment should be exercised before planting it in the northern, southern and western ranges, though any part of Indiana, climatically, is free from such influences.

The wood of the black walnut is rather heavy, hard, strong, rich dark brown color and easily worked, hence highly prized in fine finish and cabinet making. It is also a lasting timber in contact with the soil. The walnut is a rapid growing tree in good soil. At maturity it attains a diameter ranging from 4 to 6 feet and an average height of nearly 100 feet. No other tree excels it in clear straight trunk when planted in close proximity, 4 by 4 feet or 6 by 3 feet. The walnut matures to good value in 20 years, though the best value is not below 40 or 50 years. It grows rapidly for the first twenty years, but a great amount is sapwood, but from then on the growth is slower because the sapwood is transforming into heartwood and the older the tree becomes the more valuable it is. No walnut plantings have been made and harvested from which to estimate the value per acre to the planter, but from all theory involved it surely is a safe financial enterprise.

The walnut is best propagated from the seed planted in the fall of the year and stored by stratifying in the ground or in dampened sand in boxes till spring, and then planted. The stratification should be where the seeds may be exposed to freezing and thawing in order to soften the stone shell and insure quick germination. It will do well in mixed plantings with the elm, oak, ash, hickory, locust, poplar and maple, if care is exercised to prevent its being shaded out or overtopped. When planted at the distances indicated above and thinnings properly made to secure thrifty growth, I feel confident of the financial success of the walnut planting.

WILD CHERRY.

The range of natural growth for the wild black cherry is from Nova Scotia westward to the Great Lakes and to the Dakotas and south to Florida and Texas. It, like the black walnut, thrives best in the middle Atlantic and Central groups of States, but is not found so abundantly in the open prairie. In the dense forest regions of the natural range the cherry was formerly a conspicuous part of the forest growing on the rich soils, but like the other valuable hardwoods it has been sought to the almost complete exhaus-

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tion of the valuable trees at the present; especially is this so in Indiana.

The range of the economic planting of the wild cherry is extensive, though nowhere is it surer of successful propagation than in Indiana, but seeds and seedlings of southern acclimation will not thrive in northern latitudes. Such, however, is not the case with seeds and seedlings northern acclimated. By observing this caution, the bad winter killing of many wild cherry economic plantings of northern sections can be obviated.

The wild cherry is a rapidly growing tree, though short-lived, hence a splendid tree to plant in mixture where thinnings are necessary to make room for the expansion of the longer-lived kinds. In timber regions it grows to considerable size, forming a long symmetrical trunk, making it a valuable tree for saw and veneer mill purposes. In economic plantings it should be planted at close distances, 4 by 4 feet or 6 by 3 feet, in order to force a long bole, and then many thinnings for the expansion of the remaining trees. The wood of the cherry is a reddish-brown color, hard, fine-grained, durable, strong, heavy and takes on a fine satiny polish. Because of these qualities it is sought for fine interior finish and cabinet-making.

This tree propagates readily from the seeds which may be sown as soon as ripe in the fall, or they may be stratified and allowed to freeze during the winter. The manner of stratification is the same as indicated in the discourse on the black walnut. The seeds can be planted in the site where the tree is to grow, or they may be planted in nursery rows and transplanted to the permanent sites when the seedlings are one or two years old. I recommend the storage process for the seeds and the nursery planting as against the direct planting of the seeds in the permanent sites. It is a light demanding tree, therefore should not be planted in mixture with trees that will outgrow and overshade it. It can be safely planted with elm, walnut, locust, birch and ash.

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SEEDS AND SEEDLINGS FOR FOREST PLANTING.

The planting of new forests is a thing which will greatly concern the people of Indiana in the very near future. Without doubt it will command much attention in certain parts of the State where the conditions are better adapted to timber culture than most any other thing in which the people might engage. There may be many ways in which such work may be performed, but the simplest and most effective methods of planting from seeds and by homegrown nursery seedlings is recommended as giving the most satisfaction. These methods are inexpensive, and make planting possible on a large scale with small means. The following discussions may suggest some things of value to guide those who wish to engage in planting.

SEEDS.

It is very important to procure and use only good seeds in planting. This is essential to secure a stand and to prevent a waste of time and labor. The quality of seed depends largely on its being perfectly matured, the size, the age and the location in which grown.

In the instance of one and the same species of seed, the larger, heavier and mature ones are better than the smaller weakly ones. None but the former should ever be selected, because they possess greater germinating power, are more vigorous against hindering conditions of every sort. They have a greater reserve of material to aid development, the same as good seed of wheat, corn or any other agricultural product. This fact may be traced on through the life history of the tree from such seed. In cases of tests the dominant tree grew from the perfect seed.

The quality of seeds can sometimes be tested by the external appearance, but not always. Good seeds fill entirely the outer shell, are of a live, rich color and smell strongly of the characteristic odor of the tree. In all cases of heavy seeds, where it is not desired to trust to the senses of touch, sight and smell, they may be tested by throwing them into vessels of water, when the well-developed seeds will sink and the inferior ones will float.

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The germinating power of seeds is greatest just when it has ripened. It may be retained for a time, according to the species, and in case of proper treatment can be retained in perfect vigor. Some seeds must be planted immediately upon maturing, while others can be kept for some months. It is well known from natural information that all seeds ripening in the autumn do not germinate till the next season. Under favorable conditions the seed may be planted in the fall as soon as they mature, but owing to climatic uncertainties it is better to store and plant in the spring. The best time for planting in the temperate climates is April and May.

That the late maturing seeds may be kept in good condition, they should be properly treated and stored through the winter by either the earth or cool dry processes, according to the requirements of the seeds. The nuts and acorns should be divested of the hulls and cups, the cones and pods should be dried and the seeds whipped out, or the seeds may be allowed to remain in them, and the fruits should be macerated and the seeds washed out. All those requiring earth storage should be reasonably cured in the open air and light (never by fire heat), and then stored.

The manner of storing in earth is very simple. Select a well drained site and excavate to a depth of eight or ten inches, and as large as required for the quantity of seeds. Place within the excavation alternately layers of seed and earth till all are stored, cover to a depth of five or six inches with dirt, arrange the drainage so no water will stand on the seeds, and let them alone to freeze and rot till time to plant in the spring. To store in boxes is very similar. Secure boxes of such size as are needed to hold the quantity of seeds in storage, fill the boxes with sand and seeds in alternate layers, bury the box in the soil on a well drained site as in the former case and let remain till time to plant. Another method is to arrange plank boxes on the surface and store the seeds in either earth or sand as before and allow them to remain till spring. It will be found necessary to guard against rodents destroying seeds in storage as well as after planting.

When seeds are treated in the ways thus described, and if no water is permitted to stand on them, the weathering thus afforded them is the thing they need to soften the shells and insure prompt

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germination when planted. When the seeds are removed from earth storage they must be planted at once and not allowed to dry out, as that will destroy the life germ.

The trees the seeds of which ripen from September to November, inclusive, and need earth storage, are the following: Oak, hickory, ash, walnut, sugar maple, locust, chestnut, plum, cherry, persimmon, dogwood, hackberry, beech, lin, osage orange, and black gum. The trees the seeds of which ripen from August to November, inclusive, and need storage in a cool, dry, airy room are the following: Canoe and sweet birches, catalpa, sassafras, mulberry, sweet gum, poplar, cottonwood, cypress and pine. Those the seeds of which ripen in May and June, and must be planted at once, are the following: Elm, red birch, red maple, and ironwood.

The trees from which seed should be gathered and the locality are two matters which should be considered. Though all aged trees may and can yield good seed as a rule, it is better to select seed from trees which are in the prime and vigor of growth and possessing full crowns. The seeds should be selected from a locality of the same soil and climate as the area to be planted, say some authorities, while others disclaim the idea and think that the same thing prevails in this as does for seed in agriculture, and that different soils and climate should be considered in seed selection. Seeds should be secured which are good and thrifty and from trees sound and in the best growing state, and I am of the opinion that the other facts will not count for much, though with the buying of seedlings it would be quite different.

The trees best to gather from, both for good seed and convenience, are those growing in the open. The seeds of the extreme early and late ripenings should not be gathered, but the middle maturing should be selected. The tree should not be cut to secure the seeds, but shake them down and let the tree remain.

When the right season and conditions of spring come for planting, the seeds can be removed from the storage and thrown into vessels of water to clean them and detect the bad seed before planting. The storing process usually reveals the inferior seeds by their decayed and black appearance from the freezing and rottening effects of the storage. If the seed are to be planted in a

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home nursery to grow seedlings for transplanting, the nursery site should be selected and prepared for the seed before they are taken from storage.

THE NURSERY.

The site for the nursery should be a well drained and protected, though not heavily shaded spot, and of good, heavy, rich soil. The ground should be well broken up the season prior to planting, and the process repeated at the time of planting. The soil for the nursery should be thoroughly pulverized. If the nursery is to be a small one for hand cultivation it may be plotted into compartments for different kinds of seeds and for conducting areas of transplanted trees for larger ornamental plantings. The compartments may be made into raised beds or left at a level, just as the owner determines, and may be made of sizes suited to the cultivation. The rows for hand culture may be made from 18 to 24 or 30 inches wide, though for hoe culture the distances need to be very much less than for horse and plow cultivation. The furrows for the seed may be made with any device that will answer the purpose. The seed in the rows should be planted at a distance of about two inches apart and should be covered with fine soil to a depth of about twice as deep as the seed is thick, and the dirt thoroughly packed upon them. Do not do this when the soil is likely to bake very hard. Broadcast planting may be done instead of rows if desired, though because cultivation can not be given the young trees it is not as successful as the former.

If the nursery is to be of considerable proportions, the rows should be made from three to four feet apart that they may be cultivated with the plow and horse.

For extensive forest planting the seedlings should be transplanted at the end of the second year, and those having grown best may be transplanted at the end of the first year to the forest. By transplanting at these ages all the labor, digging and planting, can be performed at much advantage over larger trees. Trees which are retained in the nursery for larger size to be planted for ornament should be transplanted at least twice at intervals of two or three years. In transplanting the roots will necessarily be pruned, as will also the top, as both should always be kept in proportion, and this will cause a numerous fibrous root forma-

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tion which insures better success in living when the tree is finally planted to the permanent place.

If the seeds are to be planted directly to the area intended for the forest and in the places where they will be left to grow into trees without transplanting, then the soil must be prepared to receive them.

SOIL PREPARATION.

The preparation of soil for forest planting has been treated under the topic, "Regenerating the Farm Forest," but a better discussion here will not be amiss. Cleared land is prepared for receiving the seeds in just the same manner it is for corn planting. It is well broken, pulverized and marked off into rows either one or both ways, as desired, though it should be marked both ways to admit of cross cultivation. (The distances apart at which the rows should be made is a matter not yet satisfactorily determined, but the usual distances are from four to six feet.) The seed are then planted in the checks and covered. This may be accomplished in any manner found best and convenient. After planting, the soil should be packed thoroughly by rolling it. Any soil that will admit of this manner of preparation should receive it. If the surface is such that it can not be thus treated, the seeds will have to be planted by any means to get them into the earth and sufficiently covered. A hoe, mattock, dibble, circular spade or pick may be found serviceable means. An apron sack may be made to carry the seeds by the planter.

The number of seeds to plant in a hill will depend on the character of the seed. Fifty per cent. is considered a good average for forest seed germination. If the seeds are carefully selected and stored a larger per cent. may be obtained; but under all conditions two to the hill should be planted, and if they germinate well it is better to have to thin than to replant. A good stand should always be the aim. The thinnings can be used to transplant elsewhere.

It is advisable with certain trees to at all times plant the seed in the place where the tree is to grow permanently, while with others it is better to grow the seedlings in the nursery and transplant, and still others are better grown from cuttings. The trees,

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the seed of which should always be planted in the permanent place where the tree is to grow, are: Oak, hickory, walnut, chestnut, beech and sugar maple, though they can be transplanted at an early age with a little success. All others can be successfully transplanted from seedlings, especially when young and the conditions are anything like favorable. The poplars, willows and aspens are best grown from cuttings.

FOREST TREE CUTTINGS.

The time to make the cuttings is any time between the sap's going down in the fall and its coming up in the spring. The particularly best time is February and March. The cuttings should be made from one- and two-year-old growths of branches and ranging from one-quarter to one-half inch in diameter.

A convenient length for cuttings is eight to twelve inches. The cutting should be done with a fine sharp instrument, so as not to split the wood. The cuttings should be tied in bundles of fifty to one hundred each, the large ends all tending the same way, and the bundles then buried to prevent their drying out. They should be buried at least ten or twelve inches deep, to prevent drying. Freezing will not hurt them.

Cuttings should be set in the spring, and the ground should be prepared same as for seed if can be. They should be set in the permanent places, the same distance apart as when planting the regular forest, four feet apart. They may be set straight or slanting, as is convenient, and the earth firmly packed around them. Not more than two inches of the cutting should be left out of the ground after setting.

They should be cultivated well to keep weeds and grass down and the soil loose for growing. Where the soil can not be well plowed and pulverized a good method to set cuttings is to use a "dibble" in making openings in the ground. This instrument is handy, cheap and the best to use in such cases.

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SEEDLING TRANSPLANTING.

The preparation of the soil for planting seedlings is the same in all instances as has been given for seed planting. The making of excavations to receive the trees is the thing most difficult, to not impede rapid progress. If the trees are large and have spreading roots, the places must be made large enough to receive the roots without cramping them. It is better, therefore, to transplant the seedlings at an early age, in order to lessen the work as well as to insure better results of growing. Most seedlings at the ages of one or two years do not possess much root system, simply a straight stem with small hair fibers. If the ground is well prepared the planter can make the holes with a sharpened handspike by jabbing it into the loose soil and prying in all directions. If it can not be performed in this manner a circular spade, dibble or other implement adaptable to make the small holes necessary can be used. If the former plan is followed the planter can quickly make the holes, insert the slender root and firmly press the dirt around it. In all instances the dirt should be pressed thoroughly around the roots so that no air remains around them. To this cause may be attributed the death of many trees planted. In some instances a spade was inserted into the soil and the earth pried apart, the tree root inserted, the spade removed and the earth stamped firmly upon the roots. For planting the small seedlings various methods may be employed to make the excavations successfully.

If larger trees are planted, more work and effort will be required to make the holes and to plant the tree properly.

The digging of the seedlings should be performed in a way not to injure them. In a small nursery, and when the trees are young, a sharp spade can be used by cutting along both sides of the rows and then lifting the trees out carefully. At all times mangling the trees should be avoided. It is not essential to prune unless the trees should become broken, when they should be pruned smoothly.

The trees may be dug in the fall and heeled in over winter for early planting in the spring. Young trees in this climate

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should not be planted in the fall. The winters are too severe on them in their newly planted condition. The same thing is also true, in my judgment, for larger trees.

The trees can be heeled in in the cellar by keeping moistened dirt over the roots. The usual method of heeling trees is to dig a trench deep enough to bury the roots and the greater part of the bodies of the trees. Extend the trench east and west, the south bank sloping at an angle of about 30 degrees. Place the trees in the trench in single layers with the tops to the south and cover each layer with fresh earth. It is advisable to leave only the branches exposed. They may be left in the trench till they are taken out for planting. Select the site for the trench where the drainage is good.

When removed for planting, the roots should be plunged into a vessel containing a mixture of clay and water formed into a slush. The same thing should be done to the seedlings when taken from the nursery unless they are immediately planted or heeled in. The roots of any tree which it is intended to transplant should never be allowed to become dry.

The distances at which trees should be planted are 4, 5 and 6 feet apart for regular forest plantings, and should be in rows both ways to admit of cross-cultivation. They should be plowed or cultivated in some manner to keep down the weeds till they are large enough to survive by themselves.

The close planting enables them to soon shade the ground and thus conserve the moisture to them. Besides, it aids in natural trimming and long, straight trunk formation. Successive thinnings will be necessary when they begin to crowd and smother out.

The principle of tree growth is that if a tree is grown in the open it branches and forms a shade tree. The growth goes to limbs and branches instead of body formation. If it is crowded, it goes up in search of light, does not branch, and consequently a good trunk is formed to make the tree valuable.

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SHADE AND ORNAMENTAL TREE PLANTING.

SELECTION.

The selection of the trees for ornamental planting should be attended to with care, and only such ones chosen and planted as are hardy to the conditions at hand. Trees on public grounds are exposed to injury more than on private grounds. Any trees which can not endure moderate abuse should not be chosen. The soil of the grounds intended for planting should be studied, because differences in soil make necessary differences of tree selection and all the attending features of propagation. Because a tree is known to grow in the locality does not imply that it will grow on any spot in the community. Sandy soils and clay soils are found in alternate relation in almost any part of the State, in both strata and territorial connections, and a tree which thrives in one soil may have a struggle to exist in another. When a study of the soils has been made to determine the differences in kind and porousness and then adaptable trees selected, rightly planted and properly cared for, after-success is almost assured.

There are also other questions which should be considered before the selection of trees is made, and they are the permanent devotion of the ground to the purpose for which tree planting is done, the immediate needs and the space allotted to a tree. If the grounds under consideration are to be devoted permanently, so far as can be foretold, to the use for which it is set apart and the present needs of tree decoration are not urgent, then the long-lived trees should be chosen and such as will correspond with the other conditions of soil and moisture. If the area is not likely to be permanently devoted to the present uses, and the decoration is to fill a limited time and necessary want, then the short-lived, fast growing trees should be selected. In cases where the conditions are permanent and the needs immediate a compromise can be made by planting the different lived trees in alternate harmony. They may be planted closely and at a proper development in growth the short-lived trees can be cut out and the permanent trees left at proper distances.

In places where the space will not permit large spreading-top trees, the selection should be of trees the tops of which are more

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dense and compact. The following lists will give information concerning selections. The long-lived trees best suited for decorative plantings on permanent open grounds are the American elm, American ash, sugar maple, Norway maple, Tulip poplar, linden or basswood, American chestnut, sweet gum, sycamore, scarlet oak, red oak, white oak, yellow locust and some of the evergreens. Those best suited for limited time are red maple, ginkgo, pin oak, horse chestnut, hackberry, catalpa, Lombardy poplar, some of the evergreens and a few foreign varieties. Where the space is limited but permanent, the trees best suited and which adapt themselves to the conditions are the sugar maple, Norway maple, linden, chestnut, sweet gum, American ash, scarlet and red oak and tulip poplar. The trees which should not be planted any place for decoration are the Carolina poplar, silver maple and other similar kinds.

PLANTING.

The time and method of planting should be given the closest attention. The time is subject to difference of opinion, but such is mostly due to the object in mind. If an agent or individual cares only to dispose of his trees he may argue that any time is good for planting, but a scrupulously honest individual will not disregard the proper time to plant. In Indiana fall planting may sometimes be done to advantage, but it can not be held as a rule to practice. In all ordinary conditions early spring planting is more successful, especially for deciduous trees. The best time is immediately after the freezing is over and the soil is dry enough. The reasons given against fall planting are that the trees do not get sufficiently established root system to sustain them against the hard freezings and thawings of the winter. If it is possible the planting should be done on a cloudy, cool day, and unless the atmosphere is very moist, the trees should be kept moist by having their roots submerged in water or a thin mixture of earth and water, and only removed as they are planted. A very few minutes' exposure to the air will injure the small roots which are the feeders of the tree.

The holes for the trees should be dug a few days before the time of planting. They must be large enough so that the roots can be placed in their natural positions without the least cramp-

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ing. It is well to have a foot or more additional space on all sides of such ample depth that plenty of loose soil can be placed under the roots. In digging the holes place the top soil by itself, and if the lower soil is poor and lumpy it should be substituted by richer, finely pulverized earth for the planting. Use no manure unless it is thoroughly mixed with earth, and such should not be placed around the roots, as manure will burn and rot them. Good, clear, rich, heavy, finely pulverized soil is at all times better for tree planting. By digging the holes a few days beforehand the soil requisites can be arranged and the proper moisture conditions secured. If the earth is too wet it will afford time for proper drying out, and if too dry it will afford time to fill the holes with water and saturate till the result is satisfactory for good planting. A good drainage is essential, as but few trees will live in a place where water settles around the roots and is retained by a heavy clay.

The tree should be set at a depth of an inch deeper than it originally grew, and should be set firmly and fastened by strings tied to stakes to prevent the winds from swaying and loosening it in the ground. Be careful in doing this not to injure the bark. After planting, the ground should be mulched around with rotten substance, either of straw, tanbark or sawdust. This device will not only retain the moisture but will keep down the weeds and fertilize the soil. With this treatment watering will not be necessary except in excessive drought, in which case several gallons of water should be poured around the roots of the tree every few days until the danger is passed.

Many of the reasons for the failure of the tree to live and grow after it has been planted can be ascribed to the injuries sustained in digging it up. The roots are torn, strained and mutilated, or such scanty root system is taken up that the tree has no means of keeping up life. In digging up the tree the roots should be preserved as entire as possible and entirely practical. If the tree is of a dimension of an inch or two in diameter and of four or five years' growth, the root system should be preserved for at least three feet around the stem. Extreme caution should be exercised in retaining the small feeders. If a larger tree is taken up, a ball of earth of the dimensions above should be kept compactly intact with it and planted. Having carefully dug the trees, the roots

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should be examined and all bruised and broken roots cut away smoothly and completely. By so doing decay will not occur and fibrous roots will form quickly around all such places. Tap roots may be cut down to easy requirements for planting in the cavities. The tops of the trees should always be pruned back to harmonize with the diminished root system caused by digging. A good suggestion is the cutting of the branches back from one-third to one-half, but at no instance should they be cut to bare poles. In cutting the top back the branches should always be cut near a bud as the pruned member will always die back to the nearest bud. This will avoid the dead stubs so frequently seen on pruned trees a year or so after.

When trees are selected from the forest, they should be secured from regions open to the sun rather than from a densely shaded area, as trees from the latter places are tender and weak and will not survive the sun and open exposure. All newly planted trees should be protected on the extreme side to the sun exposure by boards or tree boxes. Figs. 1 and 2 on following page give good forms of protection and are very simple in construction.

PRUNING.

As trees become and grow older they may occasionally require pruning to remove dead limbs to improve their form and in some cases to restore them to vigor, but it seems the height of folly to prune the trees as is the prevalent custom at this time. The work of trimming shade trees in cases where it should be done should be entrusted to experienced persons only. Frequently there are parties in our cities soliciting employment as tree pruners who, by their glibness of tongue, are enabled to convince owners of their ability and obtain permission to do work for which they are the most incompetent. As a result beautiful specimens are disfigured and irremediably injured. It seems to me there is no worse injustice being perpetrated on the public than the unmerciful and unskilled trimming frequently given our shade trees in the cities.

It is true that some shade trees can be improved in appearance by an occasional trimming or cutting back in order to correct irregularities or to adapt it to a situation, and by a skilled professional pruner such work can be done without injury to the tree.

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When a tree becomes stag-headed, dead at the top, or containing dead limbs, it is necessary to correct it by cutting out such defects in a proper manner. Old trees that have become bare and unsightly may often be restored to vigor and beautiful foliage by severe pruning, but any extensive trimming of this kind is only

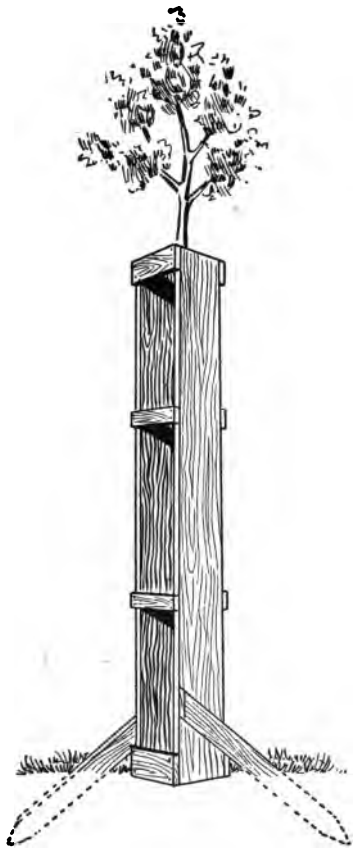

Fig. 1.

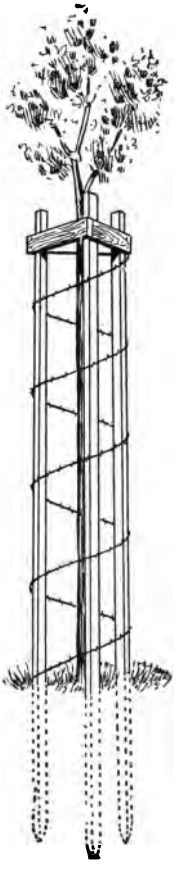

Fig. 2.

justifiable in such instances. Some trees, along walks and driveways for instance, can be more useful under certain conditions by increasing their height, which can be accomplished by cutting off their lower limbs, but this operation requires intelligent workmanship and should not be resorted to unless necessity requires.

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The best time for pruning trees is in the fall of the year soon after the leaves have dropped, though they may be pruned in the spring with safety, but it must be done early and before there is any swelling of the buds. Soft maple and other rapid growth trees may stand moderate trimming during sap season. Whenever a branch is removed, whether a dead or a live one, it must be cut off close to and even with the trunk, no matter how large the wound. The new wood and bark will then in time cover the denuded space. If a branch is not cut off close to the trunk, the projecting stub soon decays, its bark falls off and the stub remains, and the dead, decaying wood in time forms a rotten mass extending into the heart of the tree and offering lodgment for beetles and borers. Trees trimmed in the fall, as I have indicated, heal over better and do not decay.

In removing a large branch, enough of the outer portion should be cut below to prevent its weight from splitting the wood downward when the final cutting is made. All wounds made in pruning should be covered with coal tar or white lead to exclude air from the raw surface. Coal or gas tar, by penetrating parts of the wood, acts as a preservative and prevents the inroads of fungi and insects. If the pruning is done at a time when the sap exudes readily, the painting should not be done for a few days until the cut is dry, when it will adhere more readily to the wood.

It is a misery to see how many of our shade trees are defaced and mangled by unskilled trimmers. Many of our shade trees in the city, by unskilled trimming, are made full of knots, stubs, boils, cankers and deformed branches, making them examples of utter destruction as far as the purpose for which they were destined. As much to be reprehended are persons who do unskilled, unseasonable trimming as those who are polluters of society.

When an observer stops to compare the beautiful formed trees throughout the country where systematic trimming, as carried on in our cities is unknown, it ought to be evidence that constant trimming is wrong and should be abolished. I do not believe there can be found any justification for it, and I urge that persons interested in this matter use their best judgment to prevent it. The thing, it seems to me, most needed to make our trees beautiful in our cities is not trimming, but that they be planted at

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greater distances and allowed to form naturally, that they be given more opportunity to live by being relieved from many of the injuries sustained in general city improvements, both in extent and plan. I believe the time is propitious for property owners, who delight in having their property improved with beautiful shade trees, to study the subject very carefully and use their efforts to accordingly readjust the evils prevailing.

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EFFECTS OF FORESTS ON CLIMATE.

The effects of forest on climate as pertain to the temperature of the air and the soil, and to the amount of moisture and the movement of water by nature, has been observed and recorded by systematic efforts for several centuries. Volumes of records of such observations have been compiled from instances in which forest vegetation has affected the rainfall, the temperature, the moisture, the healthfulness and the stability of the soil. The quantity and the manner of the evidence is such that there is no longer reason for doubt, except as to the absolute extent of the same. The early data recorded were not very accurate, because the other agencies acting at the same time made it difficult, under the rude means used in making the tests, to determine the forest influences alone. But since 1867 very accurate, complete tests have been made and the results recorded by the authorities of France, Germany, Switzerland and India, and the same will be here given for consideration, and because no data of consequence have been completed and recorded by the American authorities. Forestry in the countries named is an institution of several centuries standing, and has developed to an almost complete, thorough, scientific study in every detail and relation. In America it is yet a comparatively new thing, and, consequently, a matter for future advancement and experiment.

The history of this scientific research by later authorities in the countries named is brief. In 1867 Dr. E. Ebermayer established a series of double stations in Bavaria, Germany. He selected a site possessing a fully stocked forest with an adjoining open country and possessing identical conditions of elevation, soil and other conditions which by any perceivable manner might influence the results. Stations were placed at different points in the forest and other parallel ones established at some distance outside in the open country. The result has been a rich lot of reliable observations and much has been learned and established. Other countries of Europe followed the example of Bavaria, and about twenty years ago similar stations were established in India. Since 1888 much improvement has been made in the manner and correct results of

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these stations, and the tabulations herein given are those of the latest observations.

EFFECT OF FORESTS ON TEMPERATURE OF THE AIR.

The results of the observations made by the stations mentioned above show that forests very materially affect the mean temperature of the air of the four seasons, and of the year. The seasons observed were Spring, Summer, Autumn and Winter, and the division of calendar months was the same as now used by us. The distance above ground at which the measurements were taken was five (5) feet. A reduction of temperature in the forest is shown by the sign (—) and an increase in the temperature is shown by the sign (+). The temperature of the open country is taken as the standard from which comparisons are made, and the temperature in the forest is shown to be so much below or so much above it, governed by the season. The same signs and distance will hold for the following tables:

Season.	*In the Open Country.*	*In the Forest.*
Spring	—1.24°F.	— .59°F.
Summer	—2.54°F.	—1.48°F.
Autumn	—1.13°F.	— .41°F.
Winter	— .61°F.	+ .05°F.
Mean of Year	—1.04°F.	— .41°F.

The above data shows that the difference of the temperature of the air is greatest in summer, smallest in winter and that spring and autumn stand about half way between.

The following table shows the result of the observations of the Bavarian stations calculated for a day of twenty-four hours by seasons. It shows only the differences of the temperature in the forest compared with that of the open country as so much above or below it, and indicated by the sign (+) and (—).

	MINIMUM.		MAXIMUM.	
Season.	*At Night.*	*8 a. m.*	*Early p. m.*	*5 p. m.*
Spring	+ .81°F.	—1.82°F.	—3.87°F.	—2.09°F.
Summer	+3.15°F.	—3.42°F.	—7.42°F.	—3.44°F.
Autumn	+2.59°F.	— .99°F.	—4.00°F.	—1.06°F.
Winter	+ .95°F.	+ .27°F.	—1.96°F.	— .99°F.
Mean of Year	+1.87°F.	—1.49°F.	—3.91°F.	—1.89°F.

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The result of these observations show that the temperature in forests is higher during the night and lower during the day than it is on the open ground, and that the difference is most pronounced in summer and autumn. Forests, therefore, tend to moderate the extremes of heat and cold. The observations of the Prussian stations for the months of July and January for a period of ten years show the following mean differences. Difference of the absolute maxima of temperature in July for ten years—5.87°F. Difference of absolute minima of temperature in January for ten years +2.70°F.

These results indicate that forests influence to lower the temperature in July and to raise it in January, which is a matter of very great concern in a climate like that of northern Germany.

The observations of the stations at different points also led to the discovery that the kind of forests had a great deal to do with moderating the extremes. In a forest of deciduous trees the extremes were moderated in July almost double what they were in pine and spruce forests. Just the reverse was ascertained of these forests in January, a fact due to the character of the foliages.

EFFECT OF FORESTS ON THE TEMPERATURE OF THE SOIL.

The effect of forests on the temperature of the soil is about as marked as that of the temperature of the air, and as the temperature of the air varies in distance from the earth so does the temperature of the soil vary from the surface downward. The observations made by stations established in the countries named for the purpose of ascertaining these facts are here given.

These figures are the differences as in the preceding table:

Season.	*Surface.*	*1 ft. below.*	*2 ft. below.*	*3 ft. below.*	*4 ft. below.*
Spring.....	—4.45°F.	—3.33°F.	—3.17°F.	—2.84°F.	—2.43°F.
Summer.....	—6.89°F.	—6.71°F.	—6.80°F.	—6.84°F.	—6.64°F.
Autumn.....	—2.29°F.	—2.41°F.	—3.02°F.	—3.29°F.	—3.64°F.
Winter.....	— .20°F.	+ .41°F.	— .04°F.	— .00°F.	— .29°F
Mean of Year.....	—4.14°F.	—3.02°F.	—3.24°F.	—3.20°F.	—3.17°F

There are several conclusions which may be drawn from this data. The first is that the mean annual temperature of the soil from one foot and downward to four is almost the same. It is also evident that the mean annual temperature of forest soil is decidedly

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lower than the soil in the open country. It is also seen that in spring the temperature is lower from the surface downward, while in the autumn the reverse is true. This is due to the fact that changes of temperature at the surface are transmitted slowly to the strata below it.

The same marked differences that were found relative to the effect of the different kinds of forest, deciduous and evergreen trees, upon the temperature of the air is also seen in the soil temperature. Evergreen trees reduce the temperature much more than do the deciduous kinds.

EFFECT OF FORESTS ON THE MOISTURE OF THE AIR.

Air can hold only a certain amount of vapor at a given temperature. The maximum quantity of vapor the air can hold at any certain time is limited by its temperature. As the air becomes heated it expands and is capable of holding more moisture, but as it becomes cooled it condenses and it can not hold so much. The quantity of moisture which the air possesses at any certain time may or may not be the amount of its capacity. Whatever the amount of moisture held by the air at any time may be it is called the absolute quantity. The proportion of the moisture which the air contains to the maximum quantity which it is capable of holding at any certain temperature is called the relative humidity of the air. When the air at any temperature contains all the moisture which it can hold it is said to be saturated and the point at which it begins to give off the moisture in any form is called the saturation point. If these facts are held well in mind the ways in which forests affect the air will be more clearly seen, since the humidity of the air depends upon the distribution of heat which is largely modified by bodies of water and surfaces covered with vegetation. The following laws govern climatic changes:

1. The quantity of heat received by the entire earth is the same for all equal parts of the orbit.

2. A heavy atmosphere displaces a light one, or a cold atmosphere displaces a warm one.

3. Changes in material produce corresponding changes in climate.

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4. Barren land areas take on heat more readily than do areas of water or those covered with vegetation and likewise give it off more quickly.

5. Barren regions have greater extremes of temperature than do regions of abundant vegetation.

6. Rainfall is greater in regions of heavy vegetation.

7. Cold air contracts and is forced to throw off its moisture while heated air expands and is capable of receiving more moisture.

A study of these laws of atmospheric changes and the causes thereof will reveal evidence favorable to forests which can not be rebutted. They can be made the means of correcting atmospheric evils to a great extent.

The following tables show the effect of forests. The measurements were taken at a distance of five (5) feet above the ground:

MEAN ABSOLUTE VAPOR TENSION IN INCHES.

Season.	*In Open Ground.*	*In Forest.*	*Excess in Forest.*
Spring	.2788	.2824	+.0036
Summer	.4626	.4618	—.0008
Autumn	.2806	.2886	+.0080
Winter	.1820	.1918	+.0098
Mean of Year	.3010	.3064	+.0054

The figures show that forests do not effect the absolute humidity of the air to any great extent.

MEAN RELATIVE HUMIDITY IN PER CENT. OF SATURATION.

Season.	*In Open Ground.*	*In Forest.*	*Excess in Forest.*
Spring	74.96	80.66	+5.70
Summer	71.92	81.20	+9.28
Autumn	82.72	87.94	+5.22
Winter	84.19	89.43	+5.24
Mean of Year	78.45	84.91	+6.36

The figures here given show the effect is very appreciable. Other observations made show that altitude has a very decided influence. At an altitude of 1,066 feet above the sea level the excess amounted to only 3.14 per cent., while at 2,956 feet elevation the excess was 8.79 per cent.

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Differences of excess were also ascertained for the kind of forests. The greater excess was found in forests of deciduous trees in the summer and less in evergreen woods. The reverse of this was found to be true for the winter season.

It is known by all who have given the matter any attention that the formation of dew is greater near forests than in open grounds, and that dry air currents entering a forest soon become saturated. Other evidences of the influence of forests on the moisture of the air might be cited, but there is no cause for the opinion frequently held that forests are producers of rainfall. It is an erroneous judgment to say that rainfall can be secured by planting and fostering a sufficient forest area. But it is not a false judgment to assert that forests by their influences aid in the supply of moisture to the air and that they conserve the rainfall to the soil by preventing hasty evaporation, retaining it in the humus and litter and by directing it into the earth by means of the roots.

EFFECTS OF FORESTS ON EVAPORATION AND WATER SUPPLY TO THE SOIL.

Because of the decreased temperature, the increased humidity and the undisturbed state of the atmosphere, the extent of evaporation must be much less in forests than in the open country. The effect of these things is, that of the quantity of the water which falls in forests a much larger part is retained to the soil than is held for the soil in the open. Omitting the fact that about twenty-five per cent. of the rainfall in forests is intercepted by the foliage, it still remains that about twice as much water penetrates the soil in forests as occurs in the open fields. As indicated in the foregoing topic, the water in forests is held by agencies which conserve it, to be taken up by the soil, and it is afterwards steadily given off to feed streams, springs and to saturate the dry currents of air which may enter the forests. They act as storage reservoirs. The figures recorded by the stations making observations of such phenomena are as follows:

1. Evaporation and escape of water from the soil in the open countries, because of the lack of conserving agencies, is placed at one hundred (100) parts.

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2. Evaporation and escape of water from the soil in forests of no leaf mold, compared to the above, is forty-seven (47) parts.

3. Evaporation and escape of water from the soil in forests of full leaf cover and humus, compared with the first, is twenty-two (22) parts.

It may be argued that trees take the water from the soil by means of the roots and pass it off by the process of transpiration and thus the soil is drier in the root regions. All this argument is true, but the soil near the surface in such instances remains very much moister than at the root depths, but with all such concessions it still remains that the evidence favorable to forests is overwhelmingly larger, and the same can not be refuted.

The tables here given show the results of the observation made, and is for the quantity of water evaporated in inches from a free surface of water:

Stations.	*In the Open.*	*In Forest.*	*Decrease in Forest.*
Bavarian	23.53	8.61	—14.92
Prussian	13.16	5.98	— 7.18
Mean	18.34	7.29	—11.05

These data show that evaporation in the forest was only about two-fifths of that in the open country.

The facts here given may not be accurate, but they surely furnish evidence for reflection and study. If the evidences submitted throughout this discussion are true to any degree, and there is no reason to doubt their absolute correctness, it is timely that forests be preserved and perpetuated for the welfare of all. The hygienic state of the country is largely governed by the climatic conditions.

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REPORT UPON A BOTANICAL SURVEY

OF THE

INDIANA STATE FOREST RESERVATION

By CHAS. PIPER SMITH

WITH ILLUSTRATIONS FROM NATURE
BY THE AUTHOR

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PLATE 1.

YELLOW PINE
(*Pinus echinata*).

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A REPORT UPON THE PLANT LIFE OF THE RESERVATION.

INTRODUCTION.

The materials for this report were obtained during a sojourn upon the Reservation between the dates of July the twentieth and August the twentieth, nineteen hundred three. The work was done at that time not from choice, but rather from necessity, and the time was, perhaps, not the best suited for the purposes in view.

The major object of the survey was to classify the trees and study their relations, and to prepare a map showing facts of importance concerning the forestry conditions. Secondly, it was desired to compile a list of the other plant life of the Reservation, making the same as complete as possible, though, considering the time limit, it was expected that perhaps one-half of the species would remain unrecorded. In this connection I wish to here acknowledge the courtesy shown me by Mr. Edwin L. Holton, who went over his notes with me and permitted me to incorporate in my list many of his records, elsewhere credited to him. Mr. Holton, now a student at Indiana University, has spent much time in systematic botanical work about Henryville, and I much appreciate the additions to the list obtained through his kindness.

While, undoubtedly, the plant list is yet far from complete, especially as regards grasses and sedges, goldenrods, asters, etc., I am quite sure that no additions will be made to the list of indigenous trees, unless perhaps other willows or haws be recognized by some future observer. Possibly, also, though contrary to my expectation, one or two additional oaks may be found at some out-of-the-way point on less frequented knob sides. For instance, a clump of easily recognized chestnut oaks, QUERCUS ACUMINATA (Michx.) Sarg., was noted on the bluff just east of Henryville, under conditions many times duplicated upon the Reservation. Again, several quite typical specimens of the scrub chestnut oak,

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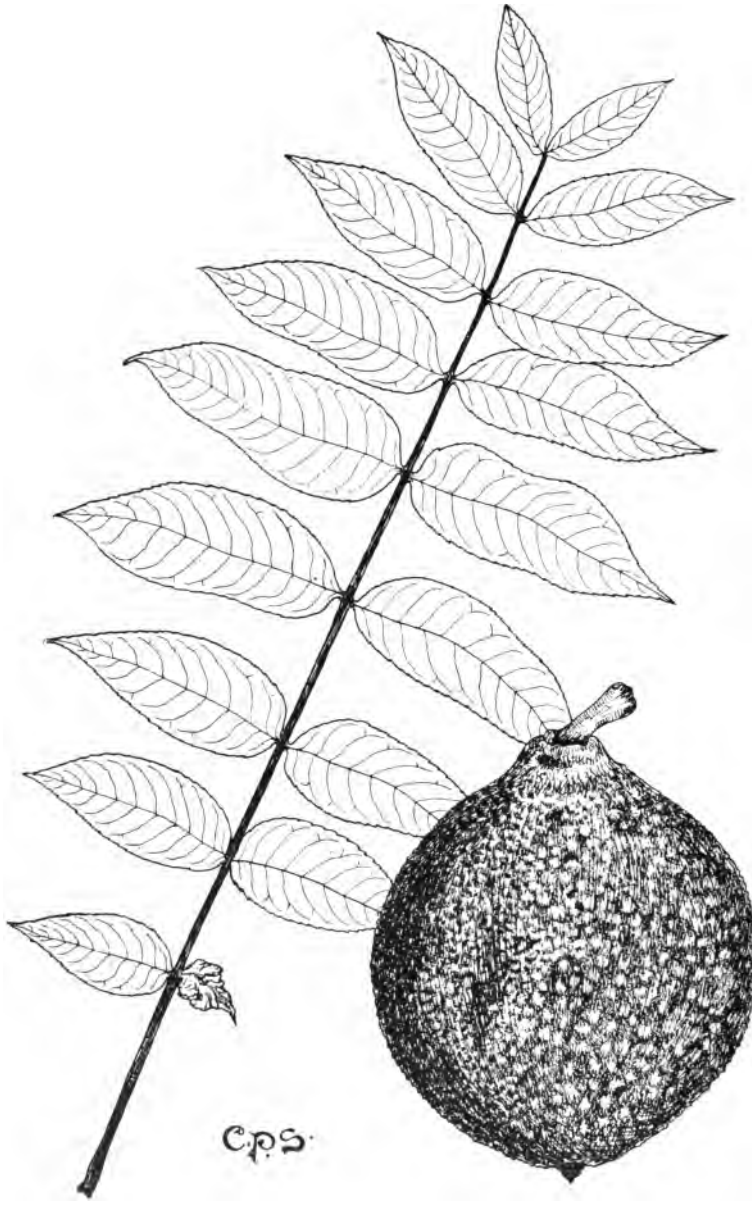
PLATE 2.



BLACK WALNUT
(*Juglans nigra*).

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QUERCUS PRINOIDES Willdenow, was observed by me under practically similar conditions (on dry knob sides) just south of Louisville, Kentucky. Rather expecting the presence of these two forms upon the Reservation, I was constantly on the lookout for them, so that my failure to note them there gives me strong ground for believing them not constituents of the flora of the Reservation.

The soil of the Reservation is a fine light yellow clay, the result of the decomposition of a soft shale, certain strata of which are somewhat, or extensively, reddened and hardened by the presence of iron compounds. This clay soil is naturally overtopped by a rich vegetable deposit in certain moist levels along the lowland streams; also on some of the ravine sides a rich mould is held in place by the roots of the abundant shrubbery. However, on many of the knob sides, where in more recent years the forest fires have licked up the soil-holding vegetation, the rains and snows of winter have easily swept from the steep slopes the loose loam and fine clay, leaving exposed the crumbling edges of the variant strata, and forming the "barren knob sides" upon which vegetation is now desparately struggling to reinstate itself.

The forestry knobs seem to be devoid of springs, and no running water was found upon the Reservation during my stay. This is partly, if not entirely, due to topographical conditions, discussed by others elsewhere in this volume. The streams, apparently, receive their supply only from rains or melting of snow. Their beds are mainly, if not entirely, of the soft, porous strata already mentioned, and much moisture is thus retained and is available to the plant life bordering their courses. Thus an extremely dry soil condition exists generally over most of the area of the Reservation. No sand was found anywhere within Reservation limits, all the so-called "gravel" being merely "chips" of the iron-bearing shale.

While many plants ordinarily indicative of rich soil are found upon the Reservation, these are necessarily of quite limited distribution, being mostly confined to the borders of the streams and to shaded ravine sides or beds; while by far the greater portion of the land is clothed by forms strongly indicative of dry, more or less sterile regions. To the botanist many of these plants have great interest because of their comparative rareness in the State.

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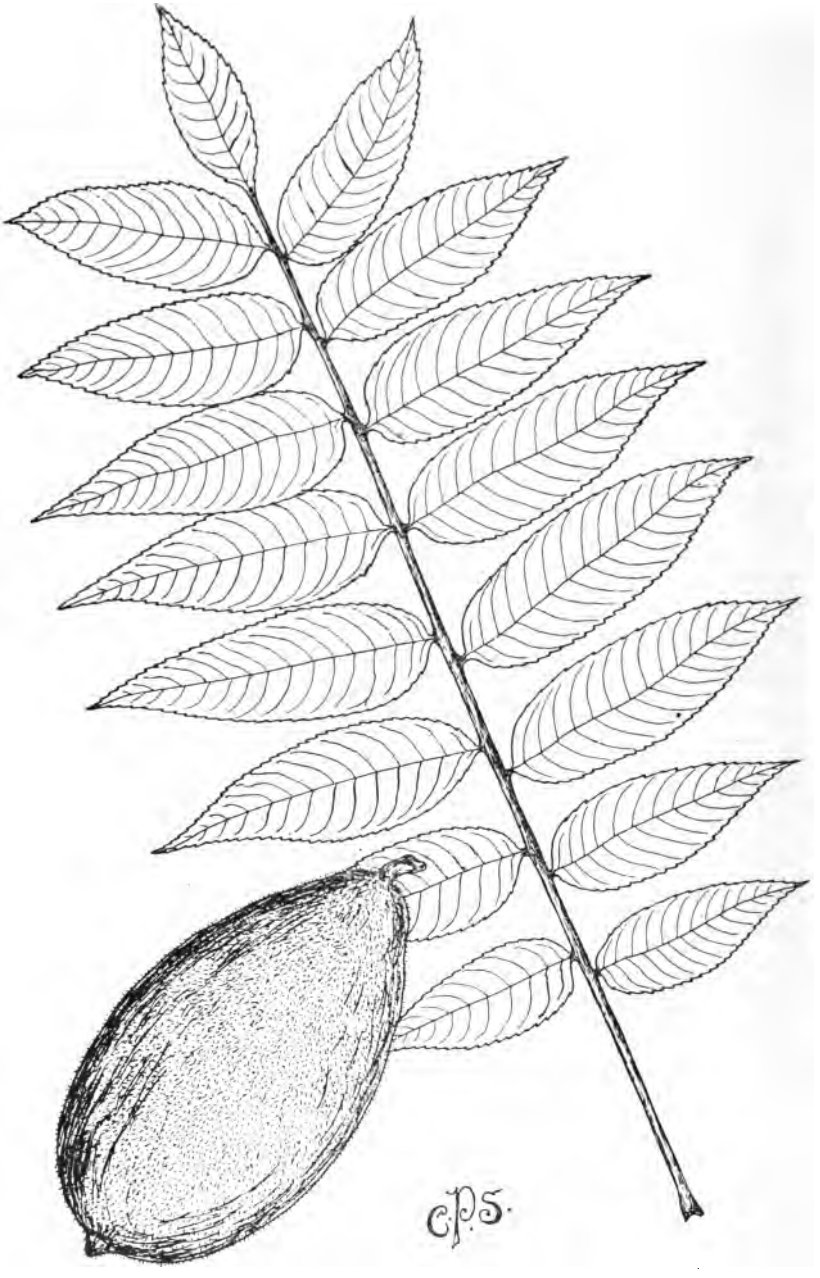
PLATE 3.



BUTTERNUT

(*Juglans cinerea*).

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In relation to forestry, however, the "story" told by the plants is that the land has decided limitations in regard to raising certain valuable timbers. Trees requiring rich, moist soil will evidently not meet with rapid development there, though they may, perhaps, be produced in limited areas. The scarlet oak seems to be best adapted to conditions upon the Reservation, for though the white oak exceeds it in point of numbers, the "scarlet" seems to be making better development under all conditions. A more particular discussion of this subject will be found in the consideration of the species separately. Much knowledge will have to be gained, however, from direct experimentation. The modern attitude, expressed in the saying, "Nothing is impossible to him who tries," may be worthy of consideration in this work. A study of the accompanying map will, it is hoped, give additional data of interest and use.

The nomenclature and sequence of species followed is that of Britton and Brown's Illustrated Flora. Though, for obvious reasons, the timber trees have been separated into a list by themselves, the sequence has not been varied.

In the pursuit of these studies the following publications were used, and my acknowledgments are due to the respective authors for the great service rendered:

Prof. Stanley Coulter's "Catalogue of the Flowering Plants and of the Ferns and Their Allies Indigenous to Indiana"—in State Geologist's Report for 1899.

Britton and Brown's "Illustrated Flora of the Northern United States, Canada and the British Possessions." 1896-'98.

Miss Kecler's "Our Native Trees and How to Identify Them." 1900.

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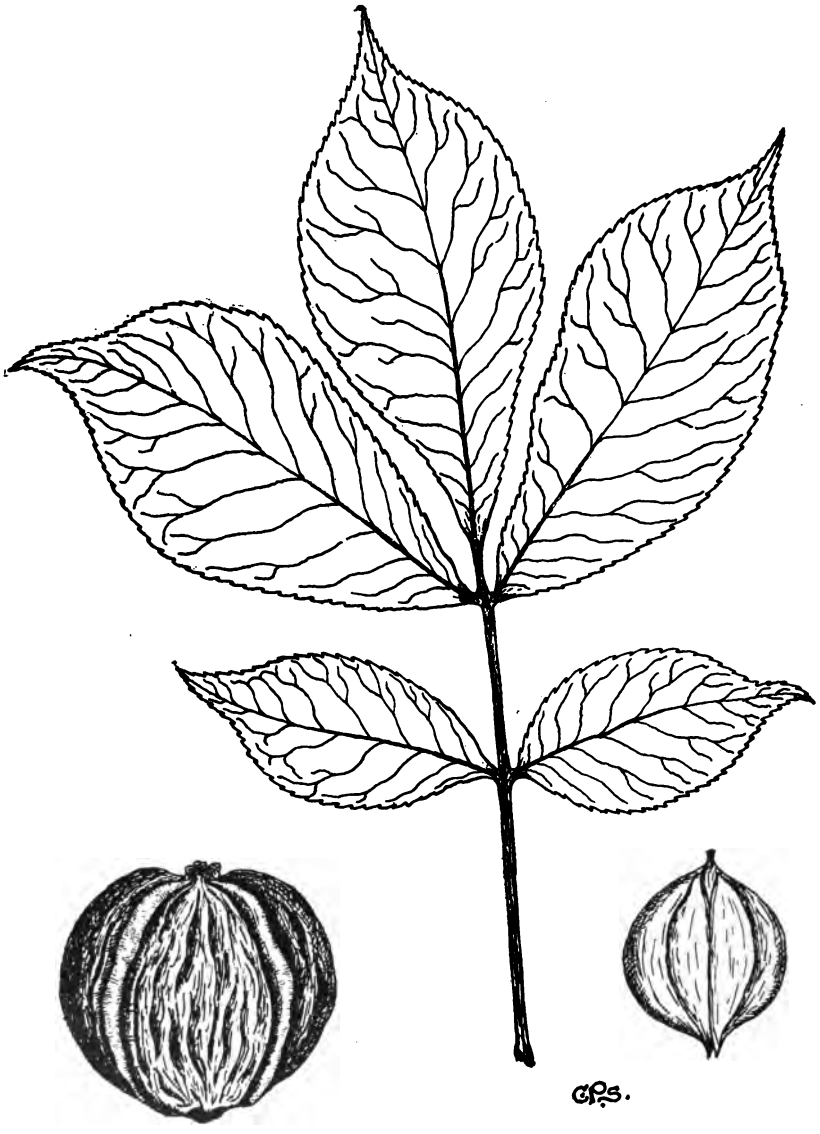
PLATE 4.



SHELLBARK HICKORY

(*Hicoria ovata*).

Leaf four-ninths natural size; fruit and nut full-size.

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THE TREE LIFE OF THE RESERVATION.

A Summary of the Indigenous Species, With Notes Concerning Their Relative Abundance and Distribution and Suggestions for Use in Determining Certain Forms.

PINUS ECHINATA Mill. Yellow Pine. (Plate 1.) The only conifer upon the Reservation. Found generally in patches, upon the crests of the knobs, frequently extending down the slopes, and also, as isolated individuals or small clumps, here and there over the lowlands. In one section, approximately located by the figure "86" upon the map, the pine averages about 133 trees to the acre, where the total number of trees averages about 520 to the acre. In the vicinity of the number "88," my calculations show about 40 pines to the acre, where an average of 670 trees to the acre includes all species. On the north and west slopes of the "Geodetic Knob" (94, on my map), two-thirds of 150 trees to the acre are pines. In the extreme northwest corner (666), about 40, out of some 500 trees to the acre, are pines. In general, trees included in my estimations are over two inches in diameter. The largest pines are about eighteen to twenty-four inches in diameter.

JUGLANS NIGRA L. Black Walnut. (Plate 2.) One of the rarest trees upon the Reservation. An occasional specimen found at various places, where its abundance did not warrant its being considered in any of the estimations made. Noted in the vicinities designated by the figures 444, 98, 66, 26, 24, and 22.

JUGLANS CINEREA L. Butternut. White Walnut. (Plate 3.) Less common than the preceding. A few fine large specimens occur in the ravine-openings marked "888" and "444." The leaves usually have only one terminal leaflet and the bark is much smoother and lighter than in the black walnut.

HICORIA OVATA (Mill.) Brit. Shag-bark. Shell-bark Hickory. (Plate 4.) The second hickory, in point of numbers, upon the

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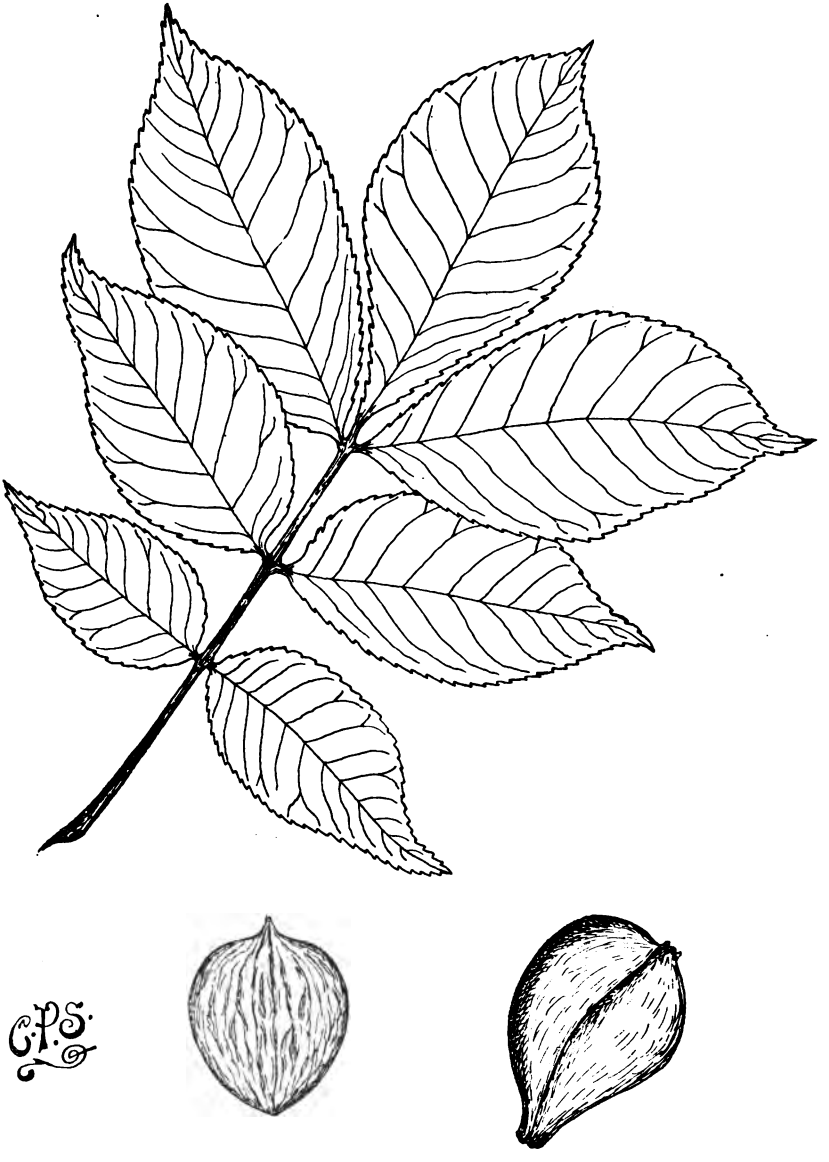
PLATE 5.



PIGNUT HICKORY

(*Hicoria glabra*).

Leaf about one-half natural size.

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Reservation. A large tree, in fruit, is easily recognized; but where five hickories occur, and a large percentage of the trees to be estimated are very young ones, too young to bear fruit and be normal in leaf and bark, I found it necessary to have my figures include all hickories at hand, regardless of species. This form is most abundant in the ravines and along streams. The fruit is about as high as wide; the hull is thick, completely separating into four portions. The nut is angled, the shell being thin. The leaves are usually of five leaflets, but sometimes seven. The bark is normally shaggy, separating into longitudinal strips. These points, I believe, will enable anyone to name most of the matured trees with which he comes in contact, remembering, meanwhile, the peculiarities of the following four species.

HICORIA LACINIOSA (Michx. f.) Sarg. King Nut. Big Shagbark. Not as common as the preceding, but occasional in similar situations. Resembling the shell-bark proper, but to be distinguished by the following indicated differences: Fruit larger, longer than wide, nut also larger, longer than wide, and thick shelled. Leaves usually with seven to nine (7-9) leaflets. The bark is indistinguishable from that of the shell-bark.

HICORIA ALBA (L.) Brit. White-Heart Hickory. Mocker-nut. Only occasional in woods near the southern and eastern boundaries. Bark rough and close; leaves pubescent, fragrant when crushed; leaflets 7-11, narrow; fruit either sub-globose or much longer than wide, the hull thick and freely separating into quarters, the shell thick; thus the fruit, alone, not easily distinguishing this species from the king nut.

HICORIA MICROCARPA (Nutt.) Brit. Small-fruited Hickory. Rare; as far as noted, confined to the richest soil of the southern boundary. Bark rather intermediate between that of the pignut and the shell-bark. Fruit nearly globose, quite small; hull thin, not completely separating from the nut; shell not angled, thin; kernel sweet, edible.

HICORIA GLABRA (Mill.) Brit. Pig-nut Hickory. (Plate 5.) The most abundant hickory upon the reservation, forming, perhaps, more than 66 per cent. of the aggregate. Found everywhere, on the knob tops and sides, in the ravines, and through-

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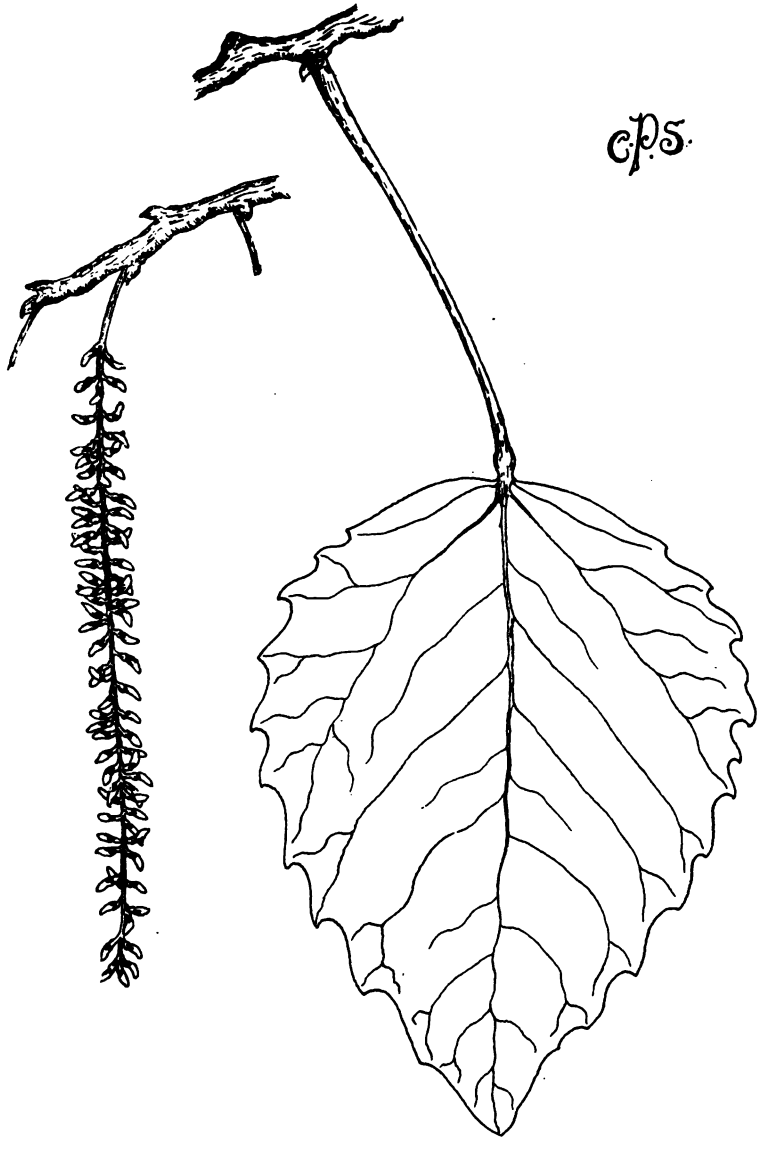
PLATE 6.



LARGE TOOTHED ASPEN
(*Populus grandidentata*).

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out the lowlands. Mature trees to be recognized by the following characteristics: Bark close and rough; leaflets 3-9, commonly 5; fruit obovoid (see illustration), hull thin, not readily separating; nut smooth or somewhat angled, shell thicker; kernel bitter, rejected by most persons.

As already indicated above, the following calculations are concerned principally with the pignut and the shell-bark, the king nuts amounting to very little in the summation. Further, it should be remembered, these percentages are largely due to sapling growth.

Vicinity	82; 220	hickories	out	of	875	trees	to	the	acre.
"	84; 340	"	"	"	1,540	"	"	"	"
"	76; 360	"	"	"	906	"	"	"	"
"	72; 150	"	"	"	790	"	"	"	"
"	54; 80	"	"	"	460	"	"	"	"
"	92; 160	"	"	"	420	"	"	"	"
"	777; 180	"	"	"	420	"	"	"	"
"	666; 120	"	"	"	500	"	"	"	"
"	555; 120	"	"	"	540	"	"	"	"
"	222; 60	"	"	"	360	"	"	"	"
"	98; 160	"	"	"	680	"	"	"	"
"	96; 10	"	"	"	210	"	"	"	"

The above estimates of total numbers of trees to the acre do not include the often superabundant sassafras, dogwood, ironwood, service berry, etc., apt to be felled in the clearing of the less valuable growth.

POPULUS GRANDIDENTATA Michx. Large-toothed aspen. (Plate 6.) Confined to the knobs and, further, mostly to the tops. Not at all common, being most in evidence in vicinities 86 and 333. Few trees are over two inches in diameter and none were noted over four inches. Easily recognized by the leaf and the smooth greenish- or yellowish-gray bark.

SALIX NIGRA FALCATA (Pursh.) Torr. Black Willow. (Plate 7; lower figure.) Frequent along the streams. Possibly other forms of this species should have been recognized.

SALIX ALBA VITELLINA (L.) Koch. Golden Osier. Occasional, along streams. Conspicuous because of its bright yellowish twigs.

SALIX DISCOLOR Muhl. Glaucous or Pussy Willow. (Plate 7; upper figure.) Also along streams, but not very common.

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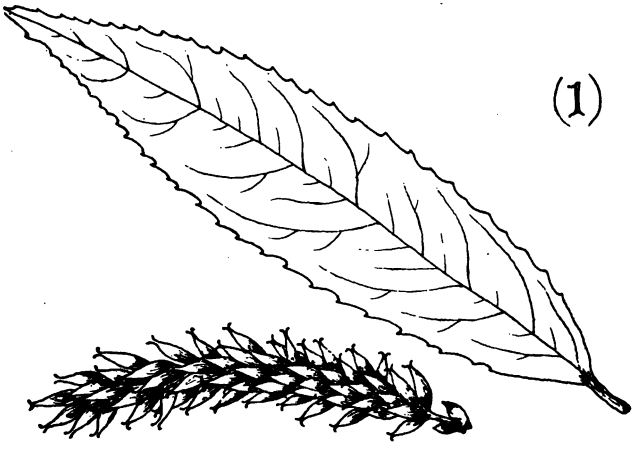
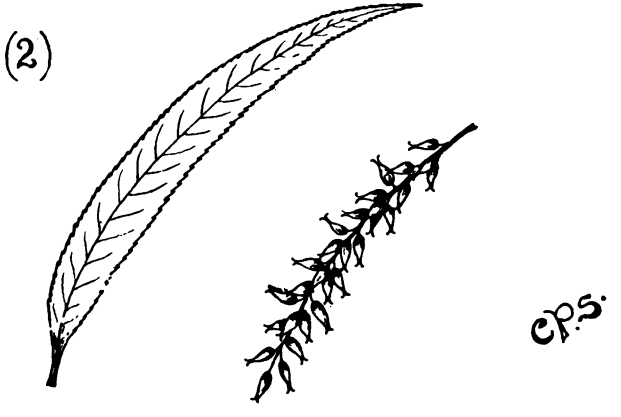
PLATE 7.





(1) PUSSY WILLOW
(*Salix discolor*).

(2) BLACK WILLOW
(*Salix nigra*).

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CARPINUS CAROLINIANA Walt. Hornbeam. Water Beech. Smooth-barked Ironwood. (Plate 8.) Frequent along some streams and in ravine mouths. Easily known by the angular stems, covered with a bark strongly suggesting the beech. Comparatively, one of the rarer trees.

OSTRYA VIRGINIANA (Mill.) Willd. Hop-hornbeam. Rough-barked Ironwood. (Plate 9.) Abundant upon the Reservation, especially in certain sections where it has advanced beyond the "sapling" stage and become a well-formed tree, four to six and seven inches in diameter. One estimate, in the vicinity 54, shows an average of 140 hornbeams, mostly of these large well-developed specimens, along with 160 large dogwoods, 40 hickories, 40 white oaks, and 20 black oaks to the acre; not many acres at these rates, however. The hornbeam is quite general in its distribution, being found, in varying abundance, almost everywhere.

BETULA NIGRA L. River or Red Birch. (Plate 10.) Common along some streams, especially those of the eastern boundary. Varying from one inch saplings to large trees almost, if not quite, two feet in diameter. Trees one foot through are common. Easily recognized by the reddish scaly bark of the trunk or limbs, in the older specimens the bark of the main stem being rough and furrowed, dark gray in color.

FAGUS AMERICANA Sweet. American Beech. (Plate 11.) This includes the three varieties known to lumbermen as the red, yellow, and white beeches. Frequent where found, but confined to the stream courses and the mouths of ravines; rare elsewhere, on knob sides and in lowland woods. Some large specimens occur, the largest being about two feet in diameter. Thriving young trees and saplings are very scarce or were overlooked. The species is too limited to have influenced my calculations.

CASTANEA DENTATA (Marsh.) Borkh. American Chestnut. (Plate 12.) Mostly confined to the knob sides, but appearing frequently over the lowlands. Much young stuff exists, often in patches, influencing much the following estimates. (The first vicinity below is entirely of very young growth, but has been temporarily trimmed out and may stand thus for two or three

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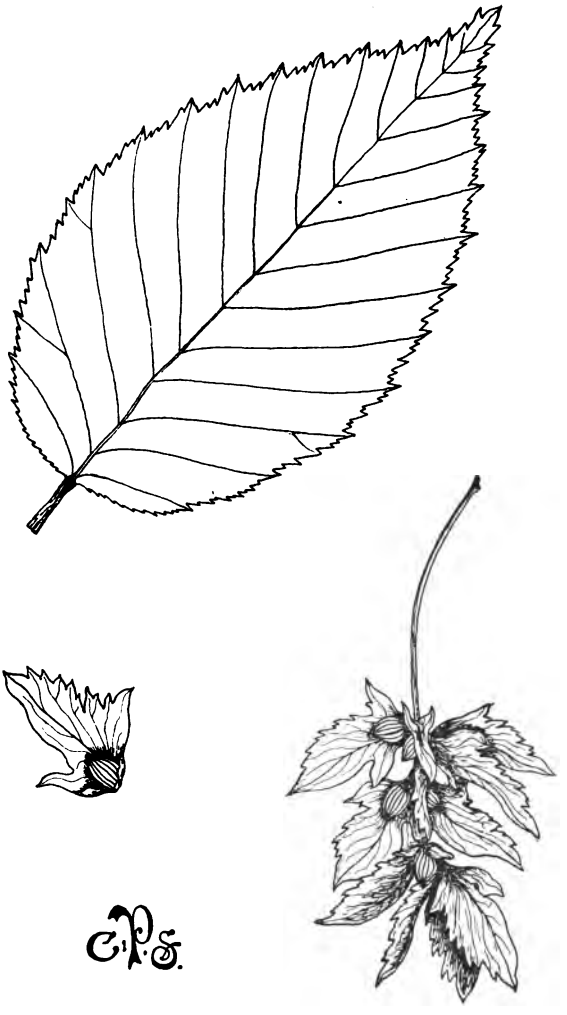

HORNBEAM

(*Carpinus Caroliniana*).

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years, or even longer. All estimates are regardless of the relative size of the trees.)

Vicinity	78;	80	chestnuts	out	of	2,720	trees	to	the	acre.
"	74;	120	"	"	"	920	"	"	"	"
"	66;	10	"	"	"	100	"	"	"	"
"	999;	100	"	"	"	780	"	"	"	"
"	888;	40	"	"	"	380	"	"	"	"
"	444;	60	"	"	"	300	"	"	"	"
"	666;	20	"	"	"	500	"	"	"	"
"	98;	100	"	"	"	680	"	"	"	"
"	96;	10	"	"	"	210	"	"	"	"

QUERCUS RUBRA L. Red Oak. (Plate 13.) Very scarce; not over a half dozen specimens noted by me. Certainly one of the rarest oaks upon the reserve, but possibly more frequent than recorded. As with many of the oaks, the acorn is often quite necessary, or most helpful, for determining some specimens of this species. By reference to the drawing it may be seen that the cup of the acorn is very shallow, in relation to the width. The acorn is usually longer than wide and not more than one-third covered by the cup. Usually the leaf is near enough to the type to serve for ready recognition of the species.

QUERCUS PALUSTRIS Du Roi. Swamp or Pin Oak. (Plate 14.) Confined to the lowlands, mostly near the southern and eastern boundaries. Not at all common and, unless in fruit, easily confused with the scarlet oak, though the average leaf is somewhat darker green above. The cup of the acorn is of the same type as the red oak, but the acorn averages shorter in relation to the width. Having the red oak-pin oak style of cup, the shape and color of the leaves should enable one to differentiate between these two species. The red oak leaf is dull light green above, the pin oak darker and quite glossy. I consider the barks too much alike for use in discrimination, at least as far as Reservation specimens are concerned. I was told that the pin oak gets its name from the fact that its branches retain their original structure far into the center of the tree, the inner ends not fusing with the heart wood as ring after ring of tissue is added without, year by year. Thus, when the timber is cut and dried, these distinct inner ends of the branches shrink and,

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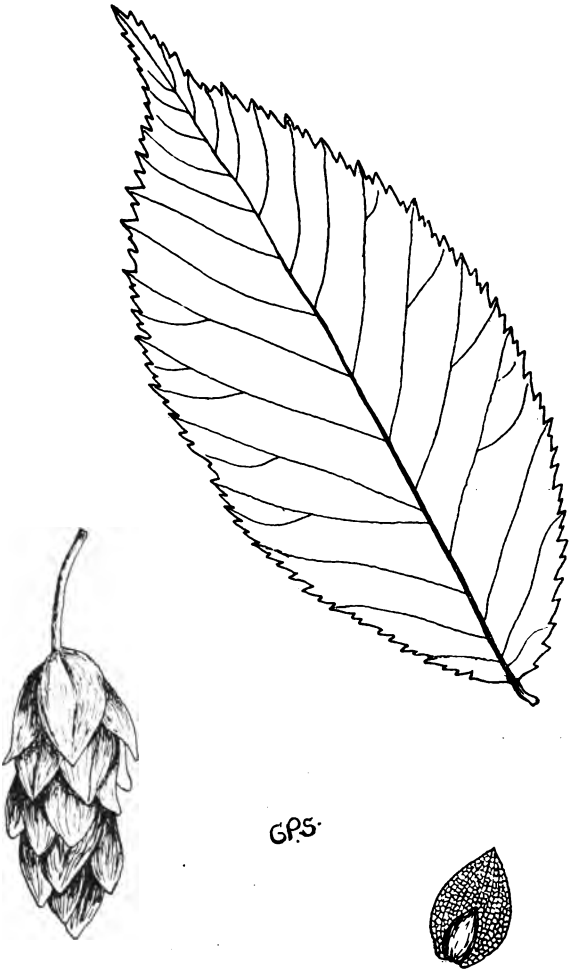
PLATE 9.



HOP HORNBEAM
(*Ostrya Virginiana*).

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as pins, penetrate the logs from all directions, the sawed lumber, even some of the more inner planks, being abundantly supplied with "knotholes." The pin oak is somewhat more densely branched than the scarlet.

QUERCUS COCCINEA Wang. Scarlet Oak. (Plate 15.) Very abundant, and, in my judgment, the most valuable timber tree upon the Reservation, because of its adaptability to the conditions existing there at present. Common almost everywhere, from fine, large "two-foot" specimens down through all sizes. Common on the knobs, as well as in the lowlands. The following figures may be of interest:

Vicinity	82;	7	scarlet	oaks	out	of	945	trees	to	the acre.
"	78;	320	"	"	"	"	2,720	"	"	"	"
"	72;	175	"	"	"	"	770	"	"	"	"
"	56;	165	"	"	"	"	830	"	"	"	"
"	54;	63	"	"	"	"	430	"	"	"	"
"	86;	46	"	"	"	"	520	"	"	"	"
"	88;	30	"	"	"	"	650	"	"	"	"
"	92;	80	"	"	"	"	420	"	"	"	"
"	94;	20	"	"	"	"	300	"	"	"	"
"	222;	100	"	"	"	"	360	"	"	"	"
"	555;	20	"	"	"	"	540	"	"	"	"
"	666;	100	"	"	"	"	500	"	"	"	"
"	777;	20	"	"	"	"	420	"	"	"	"
"	999;	30	"	"	"	"	780	"	"	"	"
"	98;	100	"	"	"	"	680	"	"	"	"
"	96;	80	"	"	"	"	210	"	"	"	"
"	32;	80	"	"	"	"	380	"	"	"	"
"	36;	200	"	"	"	"	420	"	"	"	"
"	38;	200	"	"	"	"	500	"	"	"	"
"	42;	200	"	"	"	"	540	"	"	"	"
"	64;	240	"	"	"	"	580	"	"	"	"

The recognition of the scarlet oak upon the Reservation is not difficult, since the pin oak is so uncommon and limited in distribution. However, the leaves vary from the lighter green of the red oak to the darker tint of the pin oak, and for doubtful specimens the most important move is to secure the acorn. The cup of the acorn is quite different from the red oak—pin oak type, being about twice as deep in proportion to the width (see plate). The acorn itself may vary from somewhat longer to shorter than wide, being two-thirds to one-half covered by the

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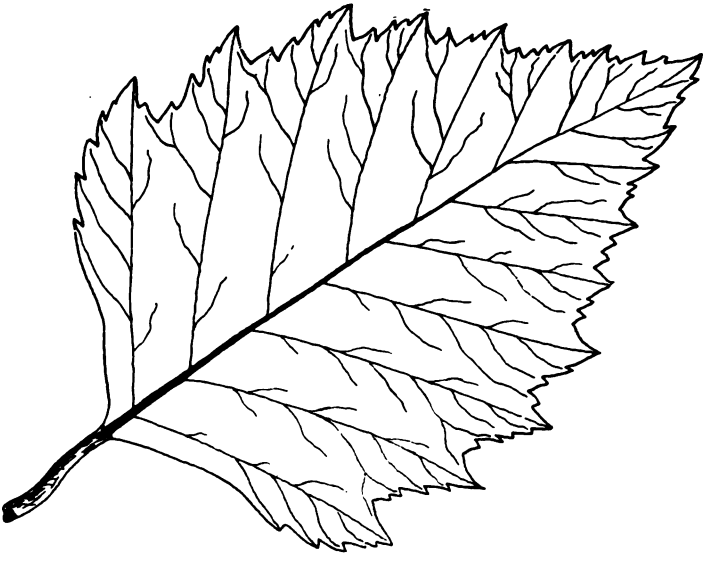
PLATE 10.



G.P.S.

RED BIRCH
(*Betula nigra*).

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cup. The inner bark of this, and the two preceding oaks, is a pale pinkish-brown in color, commonly exposed by the shallow fissures in the outer bark. Absent from vicinities 888, 444, etc.

QUERCUS VELUTINA Lam. Black Oak. Quercitron. (Plate 16.)

The fourth oak in point of numbers. Very close to the scarlet as to adaptability, development, general distribution, and value. Relative abundance and distribution are both shown by the following table:

Vicinity	62;	60	black	oaks	out	of	500	trees	to	the	acre.
"	64;	80	"	"	"	"	580	"	"	"	"
"	58;	60	"	"	"	"	600	"	"	"	"
"	42;	160	"	"	"	"	540	"	"	"	"
"	38;	160	"	"	"	"	500	"	"	"	"
"	36;	80	"	"	"	"	420	"	"	"	"
"	28;	20	"	"	"	"	380	"	"	"	"
"	96;	20	"	"	"	"	210	"	"	"	"
"	98;	100	"	"	"	"	680	"	"	"	"
"	666;	20	"	"	"	"	500	"	"	"	"
"	555;	60	"	"	"	"	540	"	"	"	"
"	222;	60	"	"	"	"	360	"	"	"	"
"	888;	20	"	"	"	"	380	"	"	"	"
"	444;	20	"	"	"	"	300	"	"	"	"
"	66;	50	"	"	"	"	100	"	"	"	"
"	94;	20	"	"	"	"	300	"	"	"	"
"	92;	20	"	"	"	"	420	"	"	"	"
"	88;	105	"	"	"	"	650	"	"	"	"
"	86;	45	"	"	"	"	520	"	"	"	"
"	54;	35	"	"	"	"	430	"	"	"	"

The outer bark of this species is quite black, rough and furrowed, but not exposing the rich orange or yellow inner bark. This last characteristic is quite constant and can be relied upon to determine specimens of extreme leaf variation. The black oak can usually be readily recognized by the large coarse leaf, four types of which are shown in the drawing. The upper right-hand type is abundant on sapling growth, the lower left-hand type being the most common form on the average well-started and larger trees. The upper left-hand figure represents the variations towards certain red oak and scarlet oak types which make advisable a test upon the inner bark. This third form is frequent on the older trees. The fourth form, that

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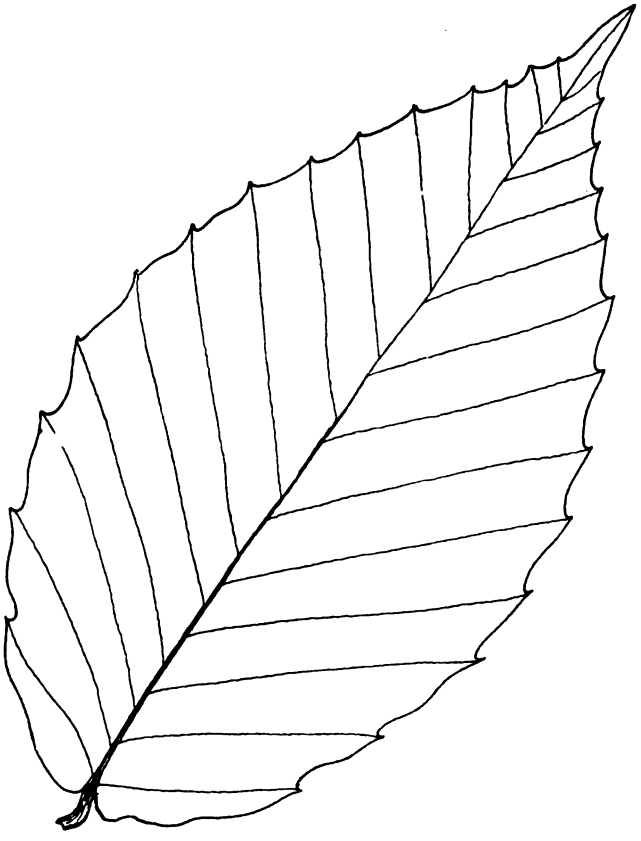

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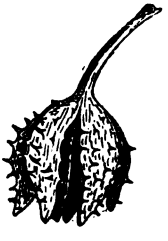

BEECH
(*Fagus Americana*).

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of the lower right-hand corner, suggests an extreme of the Spanish oak (not found upon the Reservation); but the outer and inner bark both prove it to be black oak, or at least a hybrid of this species. Only four or five trees, with this distinctly marked type of leaf, were found upon the Reservation; and one fine large specimen was noted in Scott County. This form of the black oak, if not a hybrid, certainly deserves sub-specific recognition. Acorn and cup scarcely distinguishable from those of the scarlet oak.

QUERCUS MARYLANDICA Moench. Barren Oak. Black Jack. (Plate 17.) Quite frequent in the area marked off by me as the "Barren Oak region," the most barren portion of the lowlands, as well shown by the plant life. Always associated with the post oak, which, however, has a more extended range upon the Reservation. The black jack is also occasional upon sterile knob sides. It is a dwarfish rough-barked tree with contorted boughs; seldom over one foot in diameter and twenty feet high, its thick, peculiar shaped, and exceedingly glossy leaves making its determination easy. Where found commonly, its ratio is about 40 trees amidst some 520 trees, all told, to the acre.

QUERCUS IMBRICARIA Michx. Shingle Oak. (Plate 18.) Also called peach-leaved and laurel oak, the latter term being objectionable, however, because of its application to a different species of the eastern mountains. The leaf of this oak readily distinguishes this species from all other Reservation oaks. It is scarcely more common than the red and swamp white oaks, being confined to the southeastern portions. One fine, large, well-rounded specimen and a half-dozen or more small ones exist along the stream near Mr. Richard Enlow's house. Further, occasional scattered specimens were noted in vicinities 24, 28, and 54.

QUERCUS ALBA L. White Oak. (Plate 19.) The most abundant oak upon the Reservation, indeed not equaled by any species. Several apparent hybrids were noted, some judged to be Q. ALBA x Q. PRINUS and Q. ALBA x Q. PLATANOIDES. As to relative abundance and distribution, the following table will speak:

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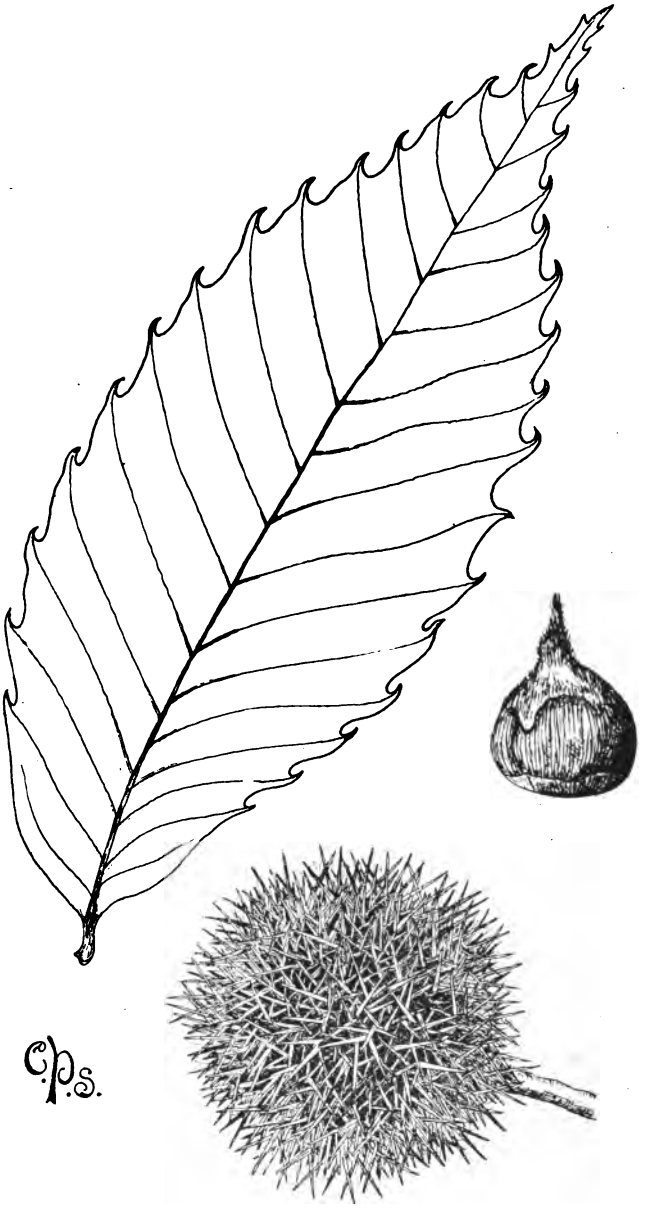
PLATE 12.



CHESTNUT

(*Castanea dentata*).

Leaf three-quarters natural size.

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Vicinity	82; 150	white	oaks	out	of	945	trees	to	the	acre.
"	78; 800	"	"	"	"	2,720	"	"	"	"
"	76; 25	"	"	"	"	900	"	"	"	"
"	72; 225	"	"	"	"	770	"	"	"	"
"	56; 295	"	"	"	"	830	"	"	"	"
"	54; 115	"	"	"	"	430	"	"	"	"
"	24; 60	"	"	"	"	180	"	"	"	"
"	26; 240	"	"	"	"	300	"	"	"	"
"	28; 160	"	"	"	"	380	"	"	"	"
"	32; 160	"	"	"	"	380	"	"	"	"
"	36; 120	"	"	"	"	420	"	"	"	"
"	38; 120	"	"	"	"	500	"	"	"	"
"	42; 120	"	"	"	"	540	"	"	"	"
"	48; 60	"	"	"	"	180	"	"	"	"
"	64; 120	"	"	"	"	580	"	"	"	"
"	62; 140	"	"	"	"	500	"	"	"	"
"	58; 300	"	"	"	"	600	"	"	"	"
"	66; 10	"	"	"	"	100	"	"	"	"
"	86; 20	"	"	"	"	520	"	"	"	"
"	88; 75	"	"	"	"	650	"	"	"	"
"	666; 20	"	"	"	"	500	"	"	"	"
"	222; 40	"	"	"	"	360	"	"	"	"
"	999; 10	"	"	"	"	780	"	"	"	"

Absent or only occasional in vicinities 888, 444, 92, 94, and 68. The leaves show little variation except in the depth of the sinuses, the two types in my drawing not doing full justice to the range of variation. The leaf, regardless of variations, usually will identify the tree without question; or the light gray scaly bark will serve, equally as well, for ready recognition.

QUERCUS MINOR (Marsh.) Sarg. Post Oak. Iron Oak. (Plate 20.) Common in the driest woods of the lowlands. As already said, always an associate of the barren oak, but more widely distributed and more abundant.

Vicinity	24; 30	post	oaks	out	of	180	trees	to	the	acre.
"	54; 14	"	"	"	"	430	"	"	"	"
"	56; 68	"	"	"	"	830	"	"	"	"
"	72; 40	"	"	"	"	770	"	"	"	"
"	58; 40	"	"	"	"	600	"	"	"	"
"	62; 40	"	"	"	"	500	"	"	"	"

Mentioned from vicinities 28 and 88. This oak is easily recognized by the shape of the leaves, which, though dulled when put beside those of the barren oak, are more glossy than those

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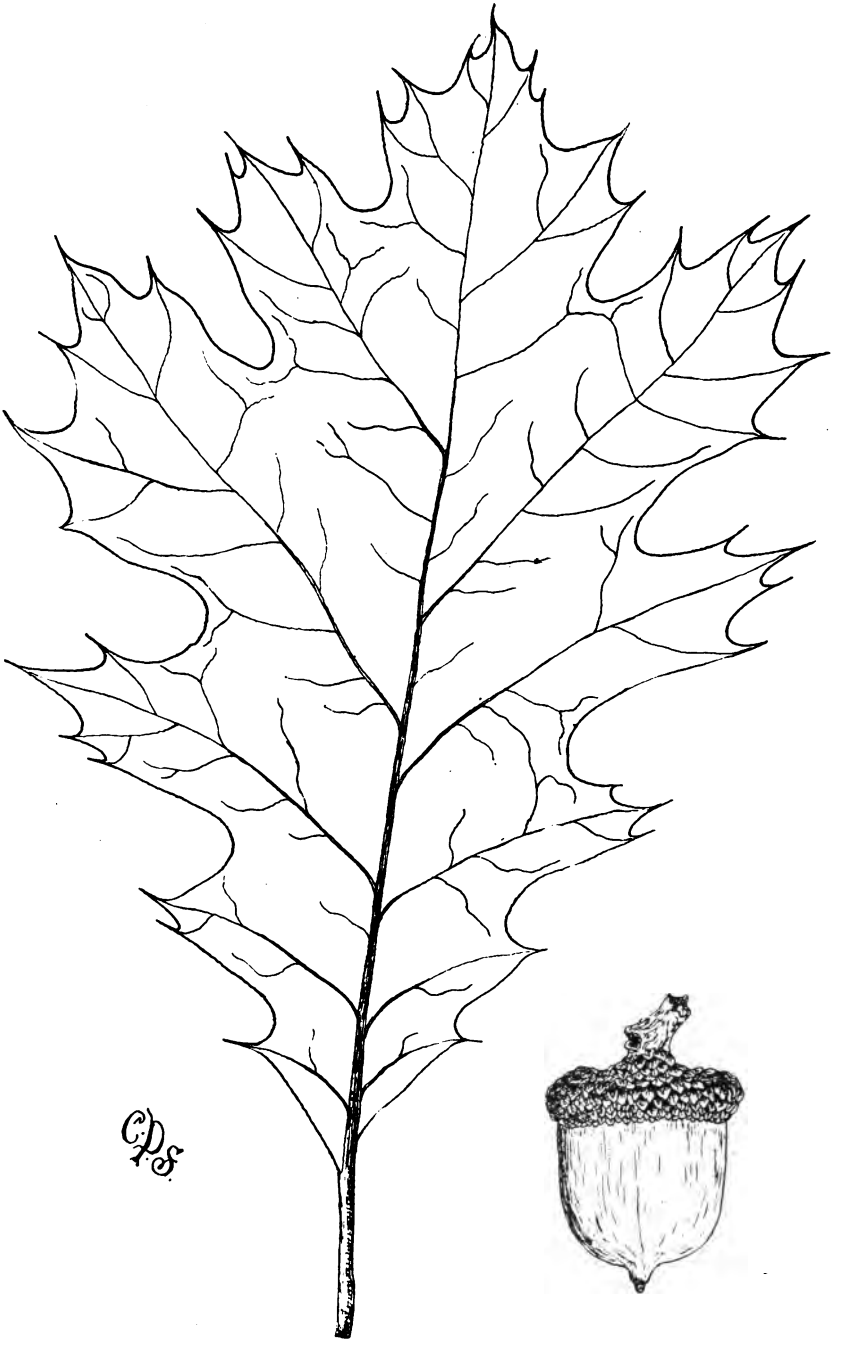

RED OAK

(*Quercus rubra*).

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of any other of the Reservation oaks. No trees were noted over forty feet high or eight inches in diameter, the average being much less. The shaft is fairly straight and slender, the branching being of white oak type. The bark is more deeply furrowed than that of the white oak and is characterized by a decided checking of the longitudinal ridges.

QUERCUS PLATANOIDES (Lam.) Sudw. Swamp White Oak. (Plate 21.) This oak is called "bur oak" about Henryville. Its importance and distribution upon the Reservation can be given in a few words. One small- and one medium-sized tree were noted along the stream through vicinity 54; and a group of some twelve or fifteen young trees are along the water course in vicinity 28. Not found elsewhere. Easily separated from the rock chestnut oak by the cup and long pedicel of the acorn.

QUERCUS PRINUS L. Rock Chestnut Oak. (Plate 22.) Abundant in the knob region and extending somewhat out upon the lowlands. As far as I could determine, this is the only chestnut oak upon the Reservation. It can be easily recognized. A table may be given for this species.

Vicinity	999;	120	chestnut	oaks	out	of	780	trees	to	the	acre.
"	777;	140	"	"	"	"	420	"	"	"	"
"	666;	160	"	"	"	"	500	"	"	"	"
"	555;	300	"	"	"	"	540	"	"	"	"
"	222;	60	"	"	"	"	360	"	"	"	"
"	98;	200	"	"	"	"	680	"	"	"	"
"	96;	80	"	"	"	"	210	"	"	"	"
"	94;	60	"	"	"	"	300	"	"	"	"
"	92;	160	"	"	"	"	420	"	"	"	"
"	88;	160	"	"	"	"	650	"	"	"	"
"	86;	123	"	"	"	"	520	"	"	"	"
"	84;	520	"	"	"	"	1,540	"	"	"	"
"	82;	410	"	"	"	"	945	"	"	"	"
"	78;	160	"	"	"	"	2,720	"	"	"	"
"	76;	175	"	"	"	"	900	"	"	"	"
"	74;	60	"	"	"	"	920	"	"	"	"
"	66;	10	"	"	"	"	100	"	"	"	"
"	64;	100	"	"	"	"	580	"	"	"	"
"	62;	100	"	"	"	"	500	"	"	"	"
"	56;	35	"	"	"	"	820	"	"	"	"
"	42;	40	"	"	"	"	540	"	"	"	"

Much of this abundance is due to sapling growth. The older trees vary from tall straight-shafted trees to low, spreading, stunted specimens with twisted, knotted stems and gnarled

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PLATE 14.

PIN OAK

(*Quercus palustris*).

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branches. The leaf characters, excepting the width, are very constant and, in my judgment, easily determine all Reservation chestnut oaks to be of the species, Q. Prinus. L., without question. However, this species seems to be unrecorded from Indiana, since Dr. Coulter recalls the record for Tippecanoe County. I have recently examined living specimens of QUERCUS ACUMINATA (Michx.) Sarg. and of Q. ALEXANDERI Britton, and am satisfied that my determination of the Reservation chestnut oaks, as recorded, is correct.

Before leaving the oaks, I will insert a condensed table showing the relations of the five common oaks to each other and of

Vicinity.	Scarlet.	Black.	White.	Post.	Chest-nut-	Total Five Oaks.	Total All Others.
24	30	30	60	30	.....	150	30
26	40	20	240	.....	.....	300	.....
28	40	20	160	.....	.....	220	160
32	80	40	160	.....	.....	280	100
34	.....	60	20	.....	.....	80	240
36	200	80	120	.....	.....	400	20
38	200	160	120	.....	.....	480	20
42	200	160	120	.....	40	520	20
48	40	40	60	.....	.....	140	40
52	100	120	140	.....	.....	360	180
54	63	35	115	14	.....	227	203
56	165	95	295	68	35	658	172
58	160	60	300	40	M	560	40
62	100	60	140	40	100	440	60
64	240	80	120	.....	100	540	40
66	10	50	10	.....	10	80	20
68	M	10	M	.....	.....	10	110
72	175	70	225	40	.....	510	260
74	.....	80	40	.....	60	180	740
76	80	80	25	.....	175	360	540
78	320	320	800	.....	160	1,600	1,120
82	7	20	150	....	410	587	358
84	M	140	400	.....	520	1,060	480
86	46	45	20	.....	123	234	286
88	30	105	75	.....	160	370	280
92	80	20	M	.....	160	260	160
94	20	20	.....	.....	60	100	200
96	80	20	.....	.....	80	180	30
98	100	100	M	.....	200	400	280
222	100	60	40	.....	60	260	100
444	.....	20	20	.....	.....	40	260
555	20	60	M	.....	300	380	160
666	100	20	20	.....	160	300	200
777	20	20	M	.....	140	180	240
888	.....	20	M	.....	.....	20	360
999	30	60	10	.....	120	210	570
Averages	80—	66+	111+	6+	88+	352	224

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SCARLET OAK

(*Quercus coccinea*).

Leaves reduced to three-fourths natural size.

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these oaks as a whole to the total of other trees, excluding, as before, the unimportant sassafras-dogwood-ironwood series. The averages resulting, however, should not be used to compute the total number of trees upon the Reservation, because the areas of the so-called "vicinities" are anything but uniform, and such should be quite uniform in order to give fair approximations.

Ulmus Americana L. White Elm. Water Elm. (Plate 23.) Common along the water courses and in the ravines. Of no great importance as far as timber is concerned, though a few fine straight-shafted specimens occur along wooded streams. Leaves smaller and not rough above.

Ulmus fulva Michx. Slippery Elm. (Plate 24.) Frequent along the waterways and in ravines; occasional in woods. Easily known by the larger leaves, quite rough above. No large specimens were noted.

Morus rubra L. Red Mulberry. (Plate 25.) Occasional under almost all soil conditions, mostly as stray saplings. No cut-leaved specimens noted. One medium-sized tree is near the southwestern corner.

Liriodendron Tulipifera L. Tulip Tree. (Plate 26.) This is the "poplar" or "yellow poplar" of the Hoosier people, but is really a magnolia. It is frequent along the Reservation's water-courses, in the ravine openings, and in the richer portions of more open woodland. Not common enough to be considered in my calculations, but recorded from these vicinities: 22, 54, 32, 68, 74, 999, 888 and 444.

Asimina triloba (L.) Dunal. North American Papaw. More or less frequent along some streams and in the large ravine openings. Noted but once or twice.

Sassafras, Sassafras (L.) Karst. Sassafras. Ague Tree. (Plate 27.) Very abundant, forming many copses in thickets and along borders of woodland, and variously found in woods as well-formed trees, two to six inches in diameter. One tree, about twenty-five feet high and one foot in diameter, is upon the Hollister knob.

Liquidambar Styraciflua L. Sweet Gum. Red Gum. Frequent in ravines, along streams and in low richer areas of woodland. In one small area, vicinity 68, a corner missed

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PLATE 16.

BLACK OAK

(*Quercus velutina*).

Leaves reduced to one-half natural size.

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by one of the fires, the sweet gum is two-thirds of the tree growth, the density rate being 120 trees to the acre. This growth contains many fine young trees, tall and slender, conical in shape. Not a few large stately trees of this species occur upon the Reservation.

PLATANUS OCCIDENTALIS L. Sycamore. Button-ball. Plane tree. (Plate 29.) Confined to the localities cited for the preceding. Not infrequent and in various stages of development, no trees over two feet in diameter being noted, however. Distribution, as limited, quite general.

MALUS CORONARIA (L.) Mill. American Crab Apple. (Plate 30.) Rather rare. Occasionally in dry areas, but mostly along water-courses at the edges of woodland.

AMELANCHIER CANADENSIS (L.) Medic. Service-berry. Juneberry. (Plate 31.) Abundant at many places in the woodland, especially in the lowlands. Represented almost everywhere. The leaf is usually noticeable for the paleness of the under surface.

CRATAEGUS CRUS-GALLI L. Cockspur Thorn. (Plate 32.) Rare. One or two fair-sized trees were found along the stream at the corner of vicinity 22. I have no record of others, but probably this does not quite do justice to the distribution of the species.

CRATAEGUS ROTUNDIFOLIA (Ehrh.) Borck. Glandular Thorn. (Plate 33.) Occasional in woods, mostly as low bushes. Leaf narrowed at the base, mostly smooth, without pubescence.

CRATAEGUS COCCINEA L. Red Haw. In woods or thickets, not common. Leaf scarcely narrowed, often heart-shaped, at base (see Plate 34), mostly smooth and without pubescence.

CRATAEGUS MOLLIS (T. and G.) Scheele. Red-fruited Haw. (Plate 34.) Occasional. Fruit hairy. Leaf not narrowed at base, pubescent on both surfaces.

CRATAEGUS TOMENTOSA L. Pear Haw. Rare. Leaf narrowed at base, rough above and pubescent below. Fruit duller red than in the others.

None of these four haws were found which had developed beyond the shrubby stage.

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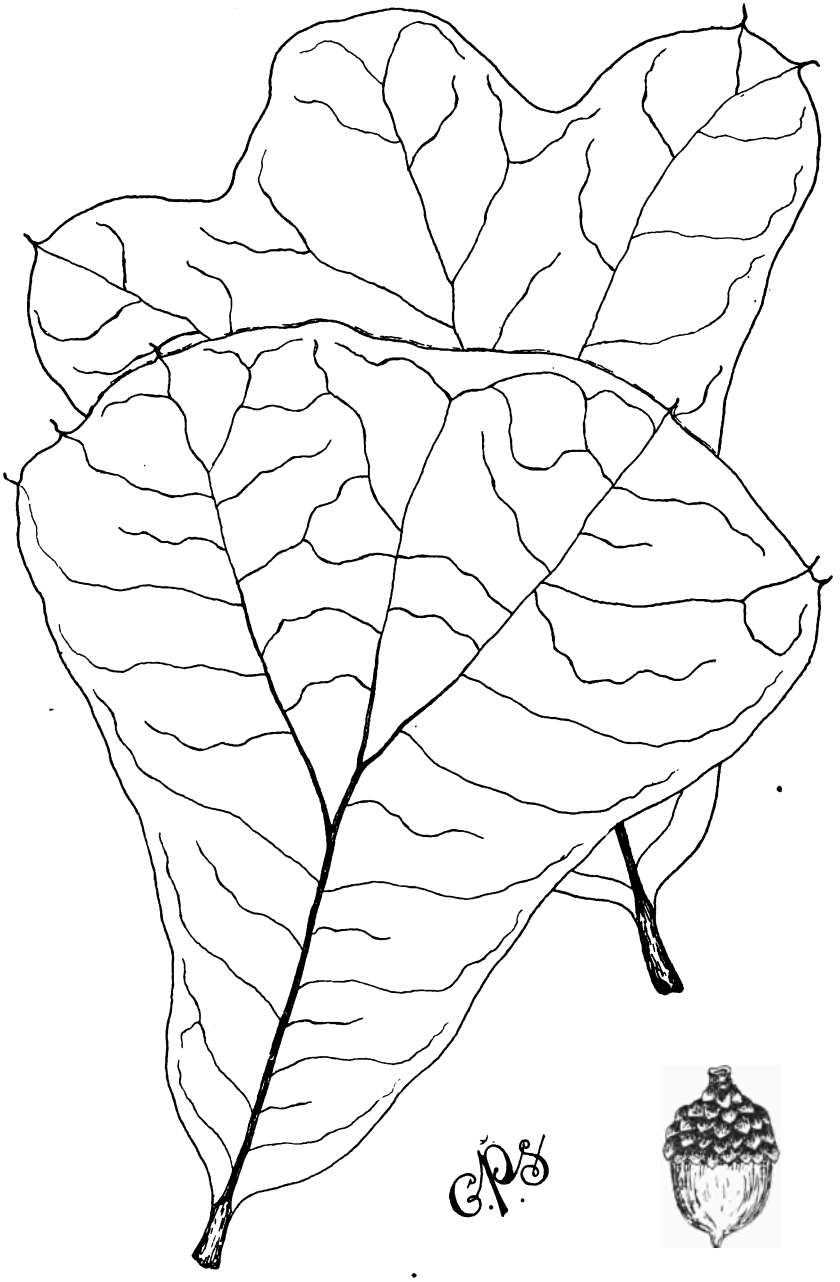
PLATE 17.



BARREN OAK

(*Quercus Marylandica*).

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PRUNUS AMERICANA Marsh. Yellow Plum. Wild Red Plum. (Plate 35.) Occasional in such places as frequented by the wild crab and associated with the same. Somewhat more common than the latter, but yet rare. Noted more than once.

PRUNUS SEROTINA Ehrh. Wild Black Cherry. (Plate 36.) Occasional at edges of woods, along streams and in ravine mouths. Not common.

CERCIS CANADENSIS L. Red-bud. American Judas-tree. (Plate 37.) Common in such situations as just recorded for the wild cherry.

GLEDITSIA TRIACANTHOS L. Honey Locust. (Plate 38.) Several small trees of this species, commonly known as "thorn tree," exist along the stream of the most western lowlands. Did not note it elsewhere.

ACER RUBRUM. L. Red, Scarlet, or Water Maple. (Plate 39.) Common in various sections, in the richer woodland. Its relations to the sum of its associates can be tabulated. The figures are largely due to small stuff, but some fair-sized trees occur.

Vicinity	34;	20	red	maples	out	of	300	trees	to	the	acre.
"	36;	20	"	"	"	"	420	"	"	"	"
"	38;	20	"	"	"	"	500	"	"	"	"
"	52;	20	"	"	"	"	540	"	"	"	"
"	54;	25	"	"	"	"	430	"	"	"	"
"	56;	10	"	"	"	"	830	"	"	"	"
"	66;	5	"	"	"	"	100	"	"	"	"
"	72;	77	"	"	"	"	770	"	"	"	"
"	76;	60	"	"	"	"	900	"	"	"	"
"	78;	160	"	"	"	"	2,720	"	"	"	"
"	84;	40	"	"	"	"	1,540	"	"	"	"
"	88;	10	"	"	"	"	650	"	"	"	"
"	444;	60	"	"	"	"	300	"	"	"	"

Also mentioned from vicinities 22, 28, 32, 48, 62, 64, 68, 222 and 666.

ACER SACCHARUM Marsh. Sugar Tree. Rock Maple. (Plate 40.) Frequent in the knob regions; especially conspicuous along the western boundary, as shown by the following table:

Vicinity	999;	250	sugar	trees	out	of	780	trees	to	the	acre.
"	888;	200	"	"	"	"	380	"	"	"	"
"	74;	40	"	"	"	"	920	"	"	"	"

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PLATE 18.

SHINGLE OAK

(*Quercus imbricaria*).

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Mentioned from vicinities 86 and 34. Some fine large specimens are in the ravine mouth "888," but most of the trees are sapling growth.

Tilia Americana L. Bass-wood. American Linden. (Plate 41.) Two small trees stand in a cornfield north of Mr. Enlow's house. The field was woodland only a few years ago, and these two trees were spared at the request of Mr. Enlow. I believe this to be the limit of the species upon the Reservation.

Cornus florida L. Flowering Dogwood. (Plate 42.) Superabundant everywhere, mostly as unshapely shrubby stuff, but reaching large size and splendid development in the central-southern portion of vicinity 54, where it and the ironwood predominate. Some of the straight-shafted well-formed larger specimens should be spared when the section is cleared.

Nyssa sylvatica Marsh. Black Gum. Sour Gum. Tupelo. (Plate 43.) Quite common and widely distributed, not in sufficient numbers to much influence the general calculations, but frequently met with, as shown by the following list of mentioned vicinities: 22, 24, 32, 34, 36, 42, 54, 56, 58, 62, 66, 72, 74, 76, 84, 96, 444, 888, 999. Many fine large trees are present. The peculiar bark, checked deeply in the "alligator-skin effect," will readily identify the tree in winter.

Diospyros Virgiana L. Persimmon. Date Plum. (Plate 44.) Frequent in ravines, along roads and streams, and in dry thickets. Fruit, picked up from the ground under the trees, October 17, was as luscious and edible as if normally frost bitten; but that yet on the trees was found to be decidedly in need of a heavy frost.

Fraxinus Americana L. White Ash. Gray Ash. (Plate 44.) Common in the richer wooded tracts. Recorded from vicinities 54, 76, 88, 444 and 888. No large trees were noted. I sought for other species of this genus, but every tree examined was of this form.

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PLATE 19.

WHITE OAK
(*Quercus alba*).

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ANNOTATED LIST OF PLANTS

Known to Occur Upon the Reservation, Exclusive of Tree Forms Already Considered.

Osmunda cinnamonea L. Cinnamon Fern. A common fern in the rich shady ravines and somewhat ascending the slopes, where conditions are favorable; mostly, if not entirely, confined to the knob region.

Onoclea sensibilis L. Sensitive Fern. Found mostly along with the preceding, but growing more in clumps.

Dryopteris acrostichoides (Michx.) Kuntze. Christmas Fern. In shady moist places in the ravines.

Phegopteris hexagonoptera (Michx.) Fée. Broad Beech-fern. Common. Found with the preceding forms.

Adiantum pedatum L. Maiden-hair Fern. Occasional, but not noted as common. All the ferns are indicative of moist, shady, rich soil.

Alisma Plantago-aquatica L. Water Plantain. Common in certain moist localities along streams, at the mouths of ravines, or wet low levels in the lowlands. Always in open places along water-ways.

Andropogon Virginicus L. Virginia Beard-grass. Abundant and very generally distributed in dry soils, in woodland (the "barrens"), or open, in the lowlands and upon the knobs. More dominant in open places.

Chrysopogon avenaceus (Michx.) Beuth. Indian Grass. Apparently confined to the district designated as the Barren Oak region. Noted as not common and scattered.

Syntherisma sanguinalis (L.) Nash. Crab-grass. Frequent in the vicinity of dwellings. Introduced.

Panicum Crus-galli L. Barn-yard Grass. Distribution as in the preceding, and also in moist soil along streams.

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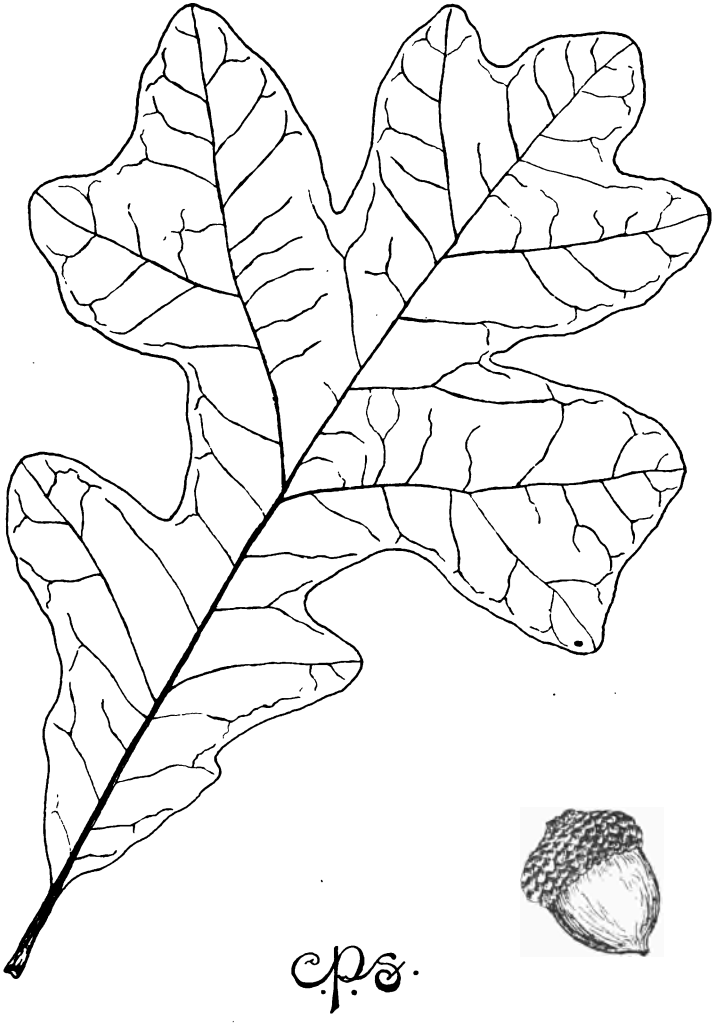
PLATE 20.



POST OAK
(*Quercus minor*).

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PANICUM MICROCARPON Muhl. Small-fruited Panicum. Quite common in the drier woods of the lowlands and also in the moist ravine-beds of the northwest corner.

PANICUM PORTERIANUM Nash. Porters' Panicum. Found in the drier woodland, especially along the wagon-ways.

IXOPHORUS GLAUCUS (L.) Nash. Yellow Foxtail. Millet. In cultivated fields and dry open places.

PHLEUM PRATENSE L. Timothy. In meadows and about the dwellings.

AGROSTIS PERENNANS (Walt.) Tuckerm. Thin-grass. Bottoms of the deeper ravines and borders of moist thickets.

AGROSTIS INTERMEDIA Scribn. Upland Bent-grass. Occasional on the dry, almost barren knob sides.

BROMUS CILIATUS L. Wood Chess. Found commonly on the shady, richer knob sides, especially well down into certain ravines.

BROMUS CILIATUS PURGANS (B. pubescens Muhl.) was taken along one of the streams.

ELYMUS VIRGINICUS L. Wild Rye. Mostly along the streams.

ELYMUS CANADENSIS L. Nodding Wild Rye. Also found along certain streams. Not noticed commonly.

HYSTRIX HYSTRIX (L.) Millsp. Bottle-brush Grass. Very common in the richer, moist ravines, extending somewhat up the ravine slopes and along streams and wagon paths away from the hills.

CYPERUS STRIGOSUS COMPOSITUS Britton. This form of the Straw-colored Cyperus is found in the wet low levels along the lowland streams. Probably other varieties also are to be found there.

SCIRPUS ATROVIRENS Muhl. Dark-green Bulrush. Abundant in low moist places along the water-ways of the opens.

SCIRPUS CYPERINUS (L.) Kunth. Wool Grass. Taken in the low moist area of the southwestern portion. One small patch there; not noted elsewhere.

CAREX BAILEYI Britton. Bailey's Sedge. Rather common in certain low moist places. Not recorded in Dr. Coulter's catalogue of the State flora. However, this sedge was carefully exam-

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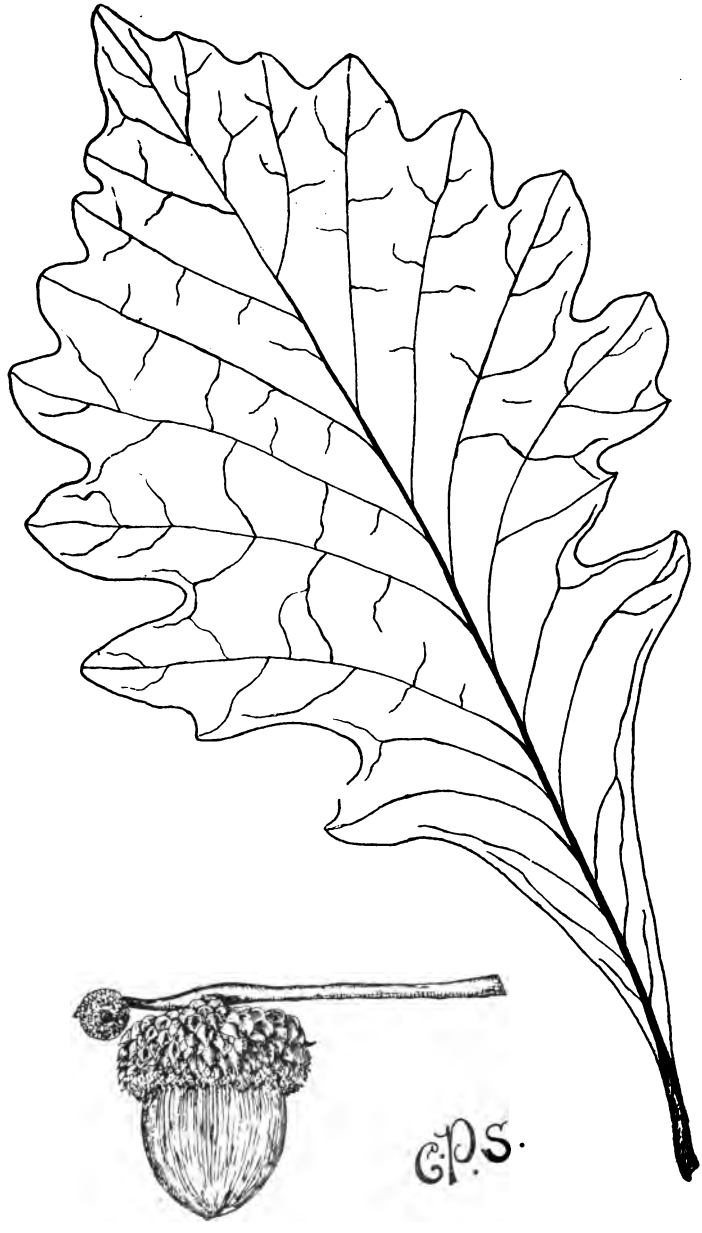

SWAMP WHITE OAK

(*Quercus platanoides*).

Leaf reduced to three-fourths natural size.

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ined and determined, and has been taken by me elsewhere in the State.

Carex Frankii Kunth. Frank's Sedge. Very common in moist places in the opens of the lowlands.

Carex squarrosa L. Squarrose Sedge. Found with the preceding. Not common.

Arisaema triphyllum (L.) Torr. Jack-in-the-Pulpit. Indian Turnip. Common in moist, shady woodland.

Juncus effusus L. Common Rush. Another form of the moist levels along the streams; even in moist open places in the deeper ravines.

Juncus tenuis Willd. Slender Rush. Common in moist open places and probably elsewhere.

Juncus marginatus aristulatus (Michx.) Coville. This well-marked variety of the Grass-leaved Rush is not reported from the State in Prof. Coulter's catalogue. It is very common in such localities as frequented by the last mentioned species.

Vagnera racemosa (L.) Morong. Wild Spikenard. Common along some of the streams and in the richer woods and shaded hillsides.

Polygonatum commutatum (R and S.) Dietr. Smooth Solomon's Seal. Frequent in such localities where the last species is found.

Smilax glauca Walt. Glaucous-leaved Greenbrier. Abundant in all neglected fields, rich or sterile, encroaching upon the borders of thickets and woods. Predominating as a form of the open. A nuisance in some cultivated fields.

Smilax rotundifolia L. Greenbrier. Horsebrier. The common Greenbrier of the woods and along streams. Generally indicative of rich soil.

Agave Virginica L. False Aloe. A common plant of the dry barren areas. Found wherever the Barren Oak occurs and occasionally upon the tops of the knobs, in poor soil.

Dioscorea villosa L. Wild Yam-root. A very common herbaceous climber of the richer shadier woodland, both of the lower levels and of the knob sides.

Habenaria psycodes (L.) Gray. Purple-fringed Orchis. Not found by myself. Reported by Mr. Holton.

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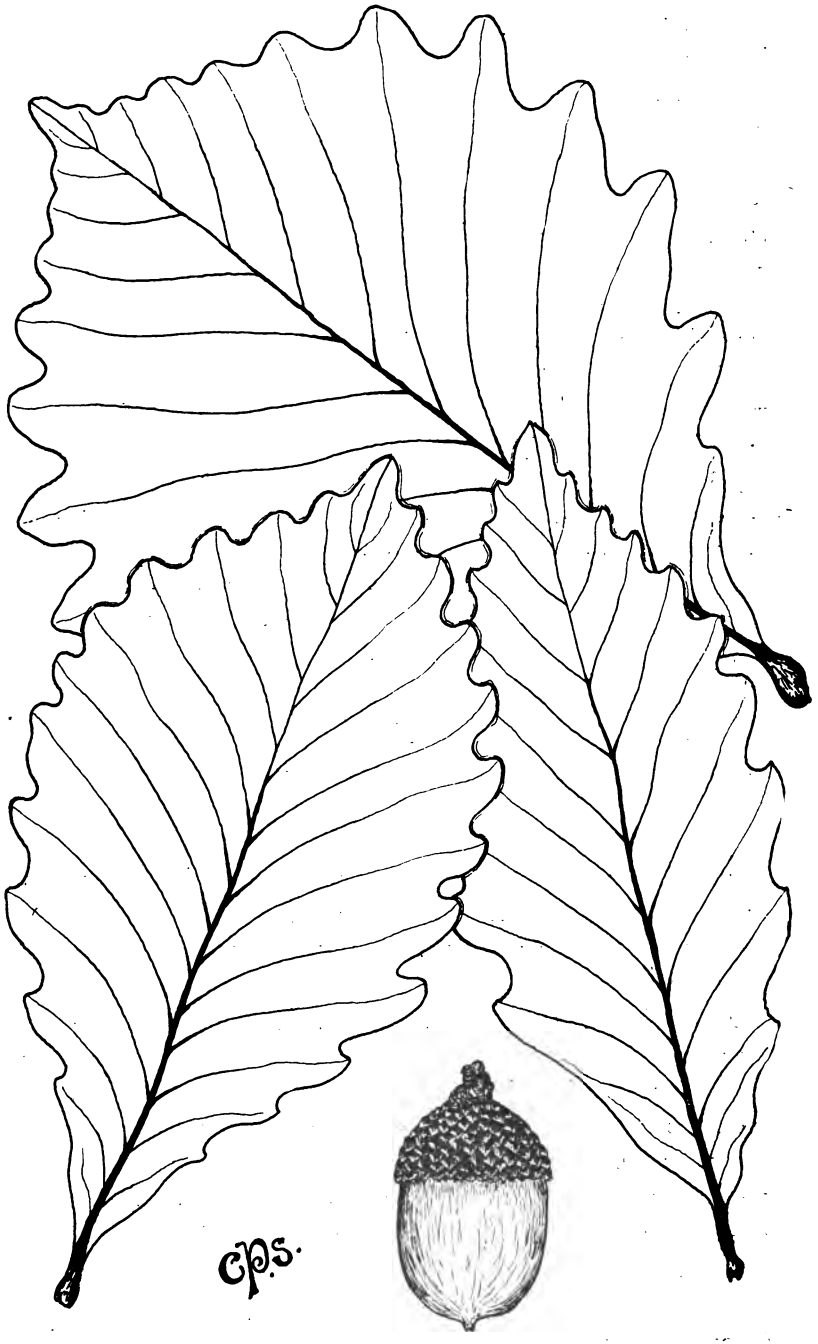
PLATE 22.



ROCK CHESTNUT OAK

(*Quercus Prinus*).

Leaves reduced to two-thirds natural size.

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Habenaria peramœma Gray. Fringeless Purple Orchis. Found rather plentifully in the large open low place along the southern boundary, westwardly. This and the preceding always stand for rich soil.

Corylus Americana Walt. Hazel-nut. In woodland, especially along streams, but locally only.

Urticastrum divaricatum (L) Kuntze. Wood Nettle. Very common in the ravines between the knob ridges, also occasionally in moist places along the lowland streams.

Adicea pumila (L.) Raf. Rich Weed. Very common in the deep ravines of the knob region and elsewhere along the streams.

Boehmeria cylindrica (L.) Wild. False Nettle. Abundant, assorted with the two preceding species.

Parietaria Pennsylvanica Muhl. Pennsylvania Pellitory. Recorded by Mr. Holton. I have no knowledge as to its abundance or distribution.

Phoradendron flavescens (Pursh.) Nutt. Mistletoe. Reported by Mr. Holton.

Asarum Canadense L. Wild Ginger. Another record of Mr. Holton's. Probably a plant of the richer knob sides.

Rumex Acetosella L. Sheep Sorrel. Very common in many of the dry open places. A rapidly spreading weed.

Rumex crispus L. Curled dock. Mostly in the vicinity of dwellings, in quite limited numbers.

Rumex obtusifolius L. Broad-leaved Dock. Associated with the last. Neither are doing much more than holding their own. Both will probably almost or quite disappear as the now waste and cultivated fields are planted in timber.

Polygonum Pennsylvanicum L. Pennsylvania Smartweed. Frequent and locally abundant in almost all moist places, along streams in the knob region (ravine beds) and lowlands, in wood and open; also about dwellings and in corn bottoms.

Polygonum Persicaria L. Lady's Thumb. Locally common, mostly about the dwellings or along the roadways.

Polygonum Hydropiper L. Water Pepper. Abundant in moist soil along the water-ways. Probably the most common smartweed on the Reservation.

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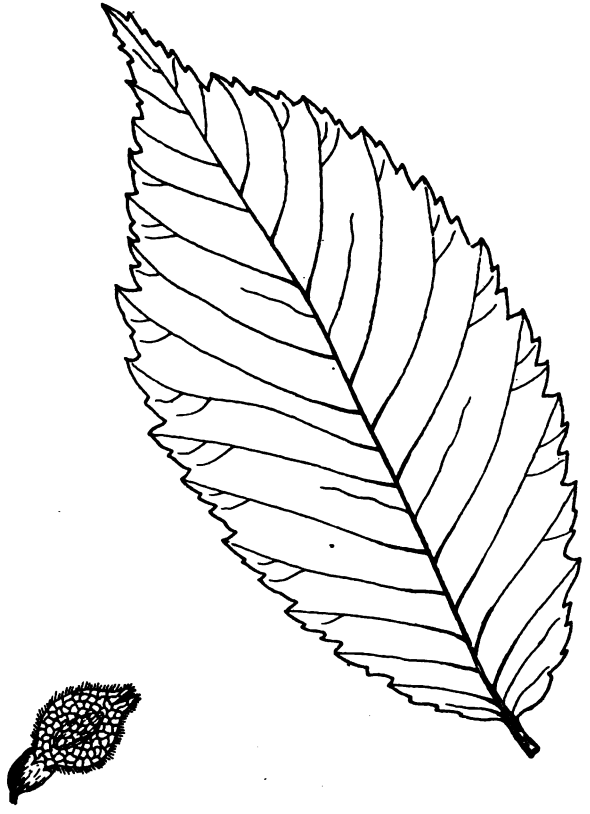

WHITE ELM

(*Ulmus Americana*).

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Polygonum Virginianum L. Virginia Knotweed. Common along streams, in rich soil, and mostly within the shadows of woodland or thicket.

Polygonum aviculare L. Doorweed. Present in more or less abundance about the dwellings.

Polygonum erectum L. Erect Knotweed. Recorded on authority of Mr. Holton.

Polygonum scandens L. Climbing False Buckwheat. A common climber over the lower vegetation along the streams, especially in the knob region.

Polygonum sagittatum L. Arrow-leaved Tear-Thumb. An almost constant associate of the Virginia knotweed, perhaps not so abundant in point of numbers, however.

Polygonum arifolium L. Halberd-leaved Tear-Thumb. Reported by Mr. Holton, not found by me. Probably rare or local in its distribution.

Chenopodium album L. White Goosefoot. Not common. Confined to the vicinity of houses.

Chenopodium ambrosioides L. Mexican Tea. About Mr. Enlow's house. Of recent appearance but spreading rapidly.

Amaranthus retroflexus L. Rough Pigweed. Common about dwellings and in the bottom-land cornfields.

Phytolacca decandra L. Pokeberry. Common and well distributed, along streams in wood and open, in moist and dry places, in clearings and along edges of woodlands and thickets, also in the deepest ravines.

Mollugo verticillata L. Carpet Weed. About houses, especially on the Hollister knob. Overlooked by myself. Recorded on Mr. Holton's authority.

Claytonia Virginica L. and

Claytonia Caroliniana Michx. Both Spring Beauties are reported by Mr. Holton. No trace of either came to my notice.

Portulaca oleracea L. Purslane. Very common in certain low cornfields.

Agrostemma Githago L. Corn Cockle. Common on the Hollister knob. Not noted elsewhere.

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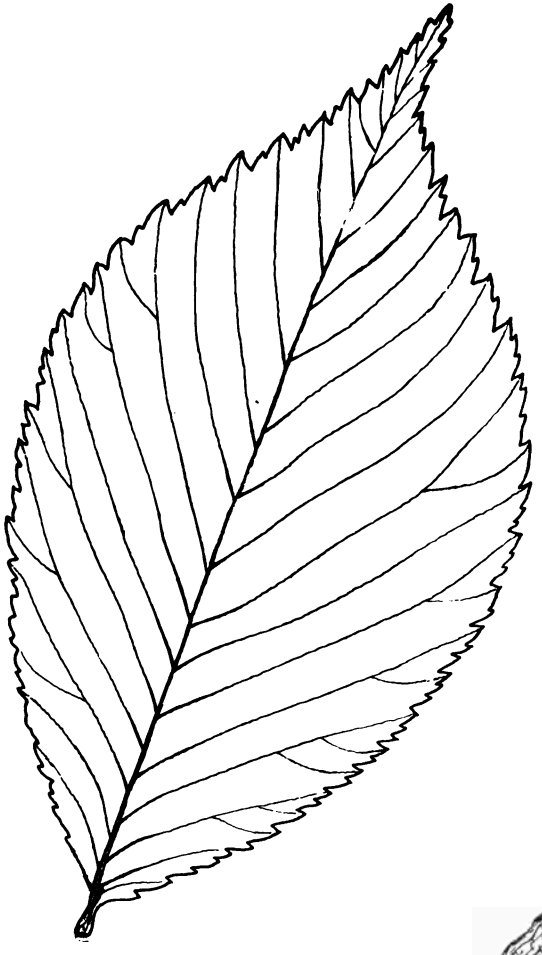
PLATE 24.



SLIPPERY ELM

(*Ulmus fulva*).

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Silene stellata (L.) Ait. Starry Campion. Noted but once, in a shady richer section of the lowland woods. Presumably one of the least common plants.

Silene Virginica L. Fire Pink. Reported by Mr. Holton.

Silene antirrhina L. Sleepy Catchfly. Frequent in neglected open places, but not common.

Hydrastis Canadensis L. Yellow Root. Frequent, but becoming rare, once abundant, I was told. Found in shady moist rich woodland, on knob sides and in lowlands.

Isopyrum biternatum (Raf.) T. & G. False Rue Anemone. Included on authority of Mr. Holton.

Actaea alba (L.) Mill. White Baneberry. Rare (?) on shady ravine sides.

Aquilegia Canadensis L. Wild Columbine. Noted by Mr. Holton. I found no traces of it.

Anemone Virginiana L. Tall Anemone. Common in woodland along streams, especially in the ravines.

Hepatica Hepatica (L.) Karst and

Hepatica acuta (Pursh.) Britton. Both Liverworts are reported as constituents of the early spring flora.

Syndesmon thalictroides (L.) Hoffmg. Rue Anemone. Another spring form not in evidence when my work began.

Clematis Viorna L. Leather Flower. Rare. Found in the deep ravines.

Ranunculus abortivus L. Kidney-leaved Crowfoot. Noted by Mr. Holton.

Ranunculus recurvatum Poir. Hooked Crowfoot. Rather common in moist shady places. Still in evidence during my stay upon the Reservation.

Ranunculus bulbosus L. Bulbous Buttercup. Recognized and reported by Mr. Holton.

Ranunculus septentrionalis Poir. Swamp Buttercup. Reported by Mr. Holton. No remnant of it noted by me.

Thalictrum polygamum Muhl. Tall Meadow Rue. Occasional in moist open woods. Indicative of rich soil.

Menispermum Canadense L. Moonseed. Commonly known in the surrounding territory, as "Sarsaparilla," its roots being used for medicinal purposes. Found very locally upon the Reser-

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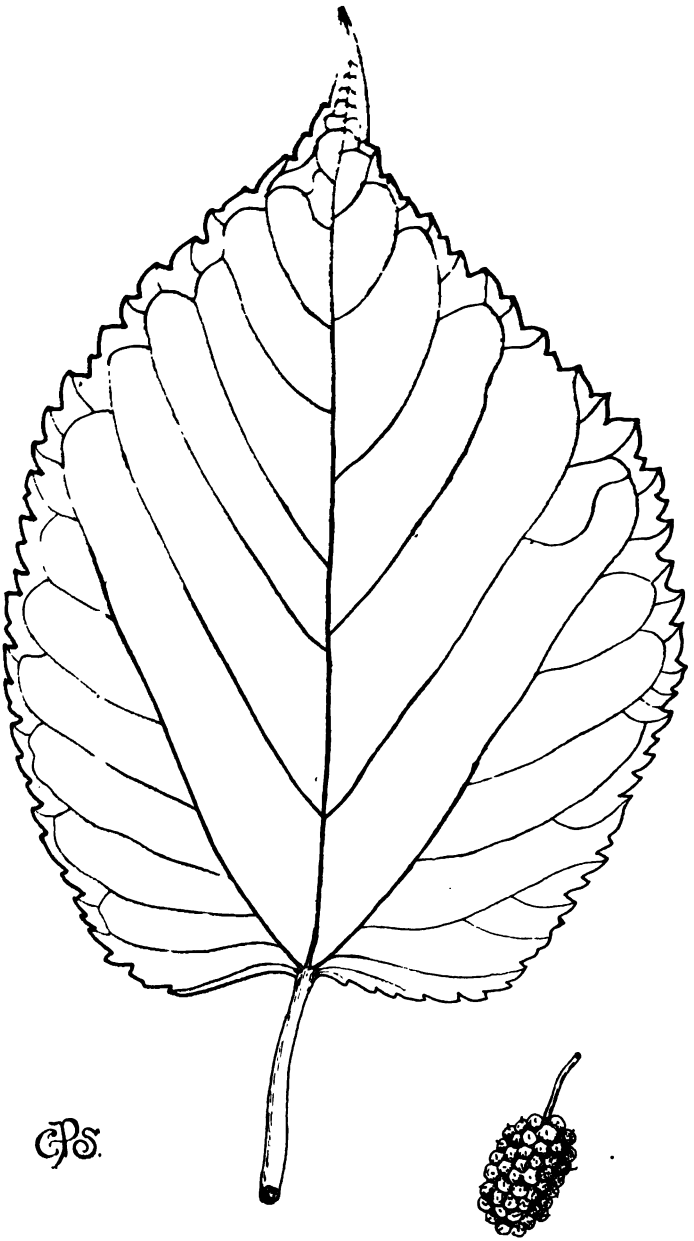

Red Mulberry
(*Morus rubra*).

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vation, along streams, especially in the larger ravines. A good indication of rich soil.

Benzoin Benzoin (L.) Coulter. Spice Bush. Not very common. Found along streams, mostly in the deep ravines.

Sanguinaria Canadensis L. Bloodroot. Recorded by Mr. Holton.

Bicuculla Cucullaria (L.) Millsp. and

Bicuculla Canadensis (Goldie) Millsp. Both the Dutchman's Breeches and the Squirrel Corn are reported by Mr. Holton. These are among the spring plants which wither away and disappear very soon after ripening their seed.

Lepidium Virginicum L. Pepper-grass. About houses. Not much in evidence.

Brassica nigra (L.) Koch. Black Mustard. In waste places about the dwellings. Not common.

Brassica arvensis (L.) B. S. P. Wild Mustard. Only a few plants noted, these being in neglected ground near an abandoned hut.

Dentaria laciniata Muhl. Pepper-root. Noted by Mr. Holton.

Bursa Bursa-pastoris (L.) Britton. Shepherd's Purse. Vicinity of houses, in neglected ground, once cultivated.

Polanisia graveolens Raf. Clammy-weed. Another of Mr. Holton's records.

Heuchera Americana Pursh. Alum-root. Common in the drier woodland, especially on the higher ridges; but not necessarily indicative of poor soil, though often growing in the poorest. Also in rich soil in the ravines.

Hydrangea arborescens L. Wild Hydrangea. Frequent in the bottoms of the deep ravines and probably frequent along streams of the northeastern boundary.

Hamamelis Virginiana L. Witch Hazel. This shrub, becoming a well formed tree in the south and southwest, is strictly a shrub as represented upon the Reservation. It is confined to the deep hollows between the knobs and is not very common generally.

Aruncus Aruncus (L.) Karst. Goat's-beard. Rather rare. In the deep ravines and along streams. Not over six specimens noted.

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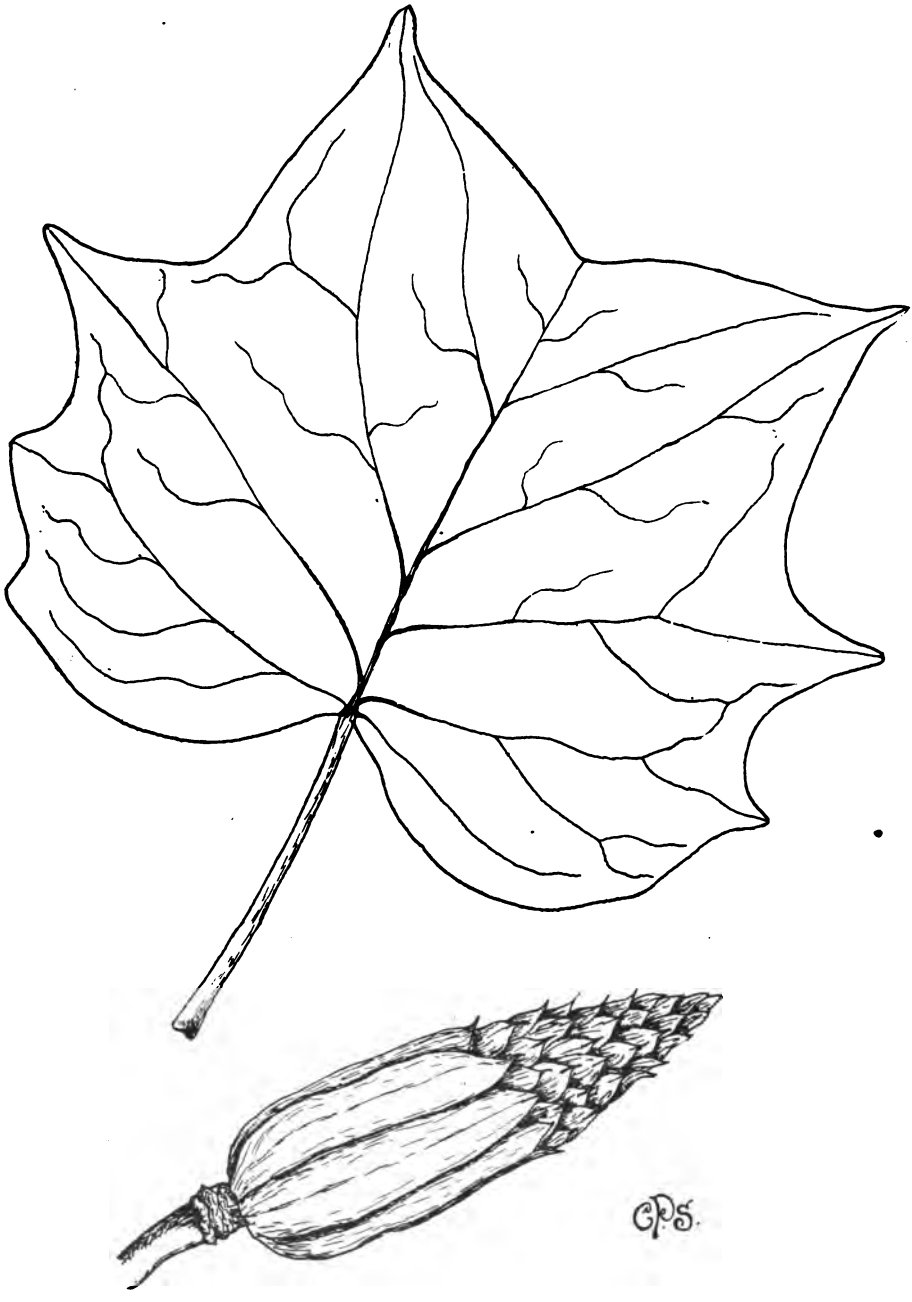

TULIP OR YELLOW POPLAR
(*Liriodendron tulipifera*).

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PORTERANTHUS STIPULATUS (Muhl.) Britton. American Ipecac. Very common and well distributed in the drier, but not the most sterile, woodland of the Reservation both in the lowlands and extending well up upon the knobs.

RUBUS OCCIDENTALIS L. Black Raspberry. Reported by Mr. Holton. Said to be uncommon and very local.

RUBUS VILLOSUS Ait. High Bush Blackberry. Abundant in the lowlands and frequent in the ravine beds. Mostly confined to neglected fields, thickets, fencerows and roadsides, but frequently plentiful in certain wooded tracts. Quite variable.

RUBUS CANADENSIS L. Dewberry. Common in certain dry neglected opens.

POTENTILLA MONSPELIENSIS L. Rough Cinquefoil. Frequent in dry neglected or cultivated fields. Local in its distribution.

POTENTILLA CANADENSIS L. Five-finger. Super-abundant in the dry neglected clearings, especially in the central and south-western portions. Covering the ground in matted stretches, often almost excluding all other plants during this plant's period of active growth.

GEUM VERNUM (Raf.) T. & G. Spring Avens. Reported by Mr. Holton. Probably common. Disappears early in June.

GEUM CANADENSE Jacq. White Avens. Common in the richer soils, especially along streams and in the large ravines. Some specimens of this form usually persist throughout the winter.

AGRIMONIA MOLLIS (T. & G.) Britton. Soft Agrimony. Common in the drier woods and thickets, especially eastwardly.

AGRIMONIA PUMILA Muhl. Small-fruited Agrimony. Not as common as the preceding. Found in similar situations and within the same range. Not reported in the catalogue of the State flora, but recorded from Kentucky by Britton and Brown.

AGRIMONIA PARVIFLORA Soland. Small-flowered Agrimony. Rather common in moist spots in the beds of ravines in the rolling and knob portions of the northern boundary. Not noted elsewhere.

ROSA SETIGERA Michx. Climbing Rose. Reported as rare by Mr. Holton.

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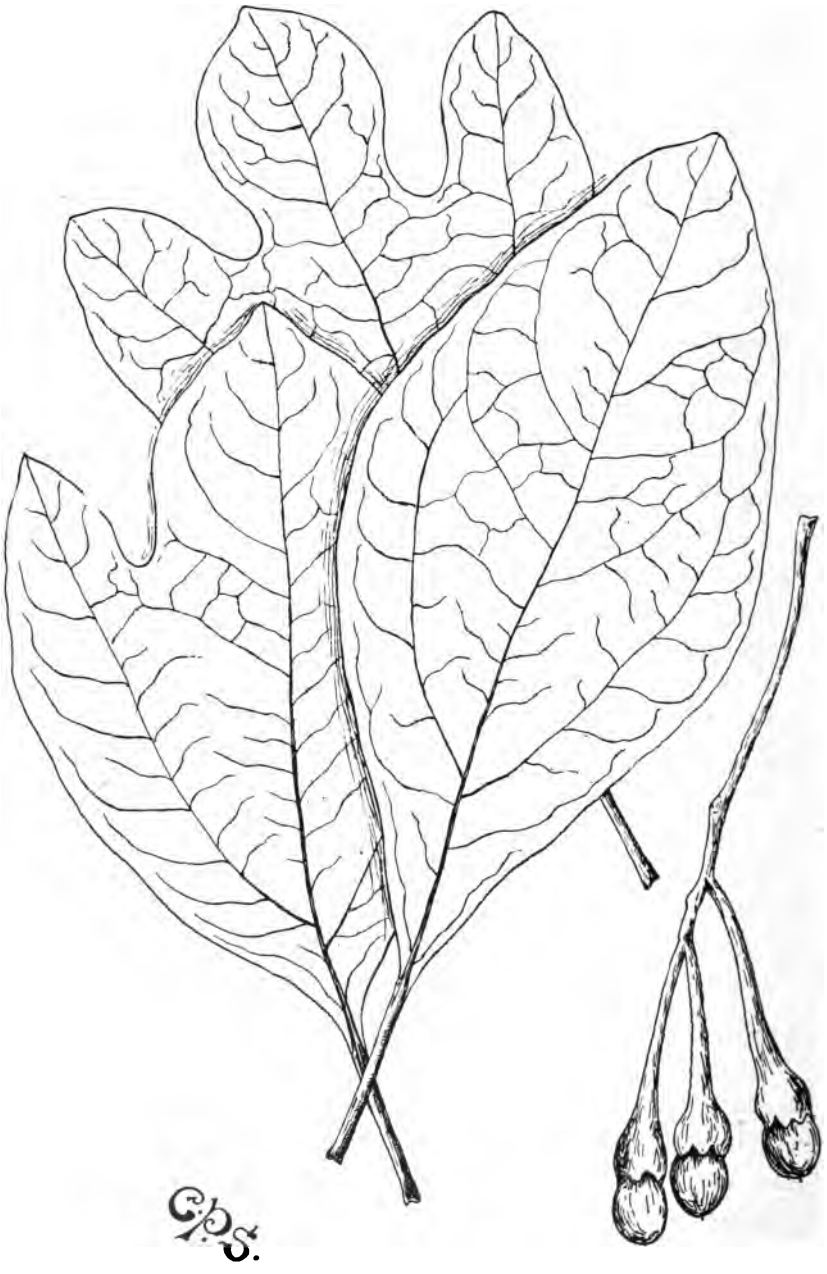
PLATE 27.



SASSAFRAS

(*Sassafras Sassafras*).

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Rosa humilis lucida (Ehrh.) Best. Common Wild Rose. Frequent in various situations and showing considerable variations. Mostly on the lowlands in dry soil.

Cassia nictitans L. Sensitive Pea. Common, locally, in dry, poor soil; most commonly noted in a cornfield in the southeastern portion.

Cassia Chamaecrista L. Partridge Pea. More common than the latter, in dry sterile soil, also in cornfields and stubble fields. This and the last species are good indicators of poor soil.

Cassia Marylandica L. Wild Senna. Common in the dry neglected open areas of the southwestern lowlands and also in moist soil along the streams. Distribution irregular. Not necessarily indicative of poor soil.

Baptisia leucantha Torr and Gray. Large White Wild Indigo. Common or rare in the dry barren timbered areas, the home of the Barren Oak. Here associated with the False Aloe, already mentioned, and with the Rattlesnake Master, Eryngium aquaticum, to be mentioned later. In fact, these three species stand together as one of the most characteristic plant societies within the range of the Barren Oak.

In regard to my determination of this species I will say that I was unfortunate in not finding a late specimen yet in bloom. The plant had not been recorded by Mr. Holton and I could get no reliable information as to the color of the flowers. A close study of the foliage and fruit, fresh and dried, several times repeated, seems to leave no question as to the correct naming of the plant; but the species is recorded as found only in moist rich soil in lowlands, not at all the condition in which the Reservation representatives exist. It is certainly not Baptisia alba (L.) R. Br. reported from the knob region near New Albany, and, all things considered, I think it best to record it as B. leucantha, it possibly deserving sub-specific recognition.

Trifolium pratense L. Common Red Clover. Variously distributed near dwellings.

Psoralea pedunculata (Mill.) Vail. Samson's Snakeroot. In dry sterile soil. Not common; noted in two definite limited patches, along wagon roads.

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PLATE 28.

SWEET GUM

(*Liquidamber styraciflua*).

Leaves three-fourths natural size.

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CRACCA VIRGINIANA L. Cat-gut. Goat's-rue. Common as an erect bushy plant in dry soil upon the tops of the knob-ridges, especially from the Hollister knob to the Geodetic knob.

STYLOSANTHES BIFLORA (L.) B. S. B. Pencil Flower. Frequent within a very limited area, within the range of the Barren Oak. In dry soil along wagon ways. Associated with Lespedza repens. One of the rarest plants of the Reservation.

MEIBOMIA NUDIFLORA (L.) Kuntze. Naked-flowered Tick-trefoil. Can include this plant only on the authority of Mr. Holton.

MEIBOMIA GRANDIFLORA (Walt.) Kuntze. Pointed-leaved Tick-trefoil. Common in the richer woodland, especially on the more shaded knob sides.

MEIBOMIA MICHAUXII Vail. Prostrate Tick-trefoil. Frequent in the drier and shadier woods, but not in the Barren Oak belt.

MEIBOMIA SESSILIFOLIA (Torr.) Kuntze. Sessile-leaved Tick-trefoils. Common in dry open territory, invading thickets.

MEIBOMIA CANESCENS (L.) Kuntze. Hoary Tick-trefoil. One of the most common tick-trefoils upon the Reservation. Found in the opens, especially at the edges of woods and along streams.

MEIBOMIA BRACTEOSA (Michx.) Kuntze. Large-bracted Tick-trefoil. Only a few specimens noted. Found in dry soil of the opens, near or in open thickets.

MEIBOMIA PANICULATA (L.) Kuntze. Not observed by me; reported by Mr. Holton.

MEIBOMIA DILLENII (Darl.) Kuntze. Dillen's Tick-trefoil. A common plant in the drier woods and thickets where somewhat open.

MEIBOMIA MARYLANDICA (L.) Kuntze. Smooth Small-leaved Tick-trefoil. Common in dry open territory.

LESPEDEZA REPENS (L.) Bart. Creeping Bush-clover. Frequent in dry open places, especially along roads through the Barren Oak region. Limited in distribution.

LESPEDEZA PROCUMBENS Michx. Trailing Bush-clover. Much more common than the preceding and much more widely distributed, growing in dry and somewhat moist soil in thickets and open woods, in lowland and knob region.

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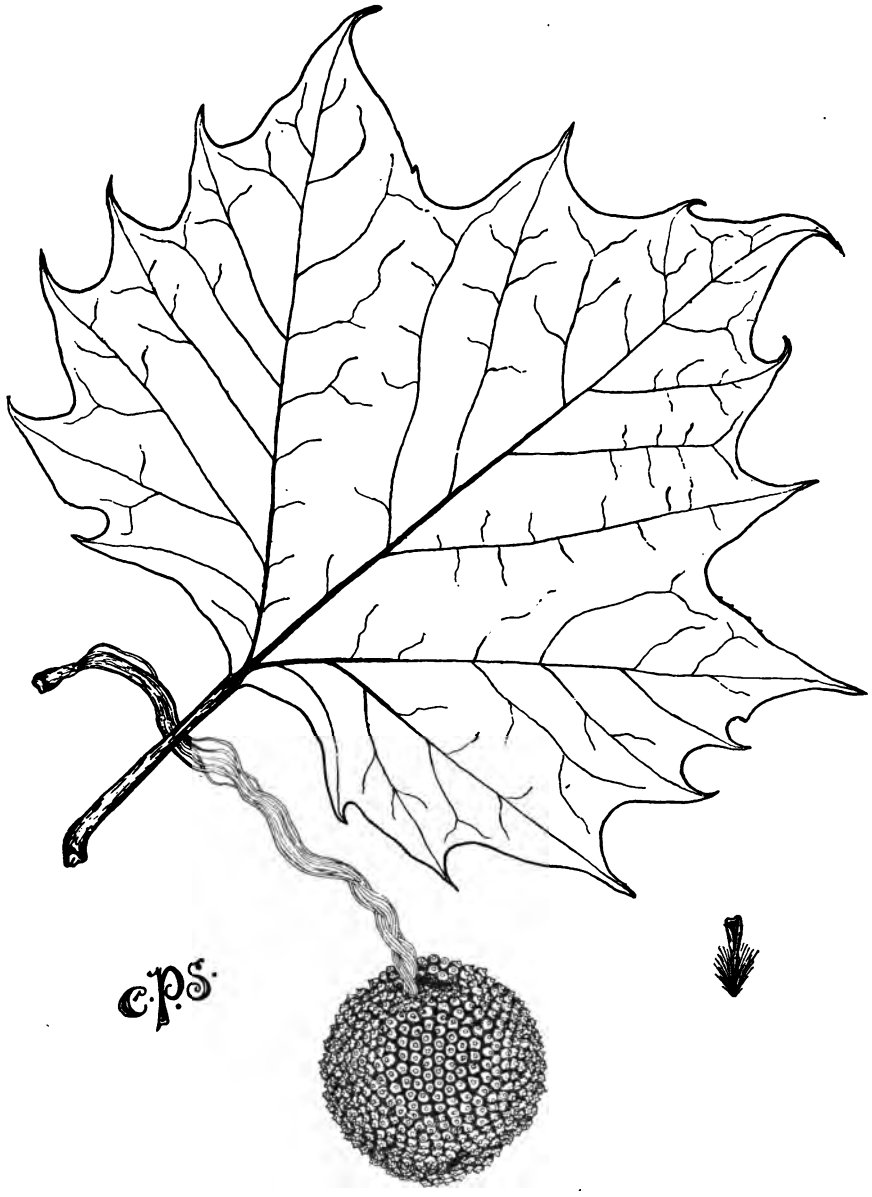
PLATE 29.



SYCAMORE

(*Platanus occidentalis*).

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Lespedeza violacea (L.) Pers. Bush-clover. Common on the dry, more or less exposed, knob-sides and at the edges of the dry lowland woods.

Lespedeza frutescens (L.) Britton. Abundant in dry soil, in lowland and on the knobs, associated with the last where that form occurs.

Lespedeza hirta (L.) Ell. Hairy Bush-clover. Very common in dry soil, especially in the dry woods of the southern lowland portion.

The last three plants are strong indicators of dry, poor soil.

Vicia Americana Muhl. American Vetch. Common in a richer stretch of shady woodland of the eastern central portion. Not noted elsewhere.

Falcata comosa (L.) Kuntze. Hog Pea-nut. Frequent in moist shady woods.

Apios Apios (L.) MacM. Ground-nut. Reported by Mr. Holton.

Phaseolus polystachyus (L.) B. S. P. Wild Bean. Common near the top, along the road up the Hollister Knob. Not noted elsewhere. A luxuriant climber or trailer.

Strophostyles umbellata (Muhl.) Britton. Pink Wild Bean. Common in the dry neglected or stubble fields of the southwestern lowlands. An inconspicuous trailer. Indicative of poor soil.

Oxalis stricta L. Yellow Wood-sorrel. Not at all generally distributed, but found at various points and in various conditions, generally in the open, moist or dry. Not indicative of any soil condition.

Linum Virginianum L. Wild Yellow Flax. Frequent in dry woodland, especially in the "foot-hills" of the knobs.

Polygala ambigua Nutt. Loose-spiked Milkwort. Common in dry neglected openings at the foot of the Hollister Knob. Not noted elsewhere.

Acalypha gracilens Gray. Slender Three-seeded Mercury. Very common in many fields and waste places. The material handled carefully was of this species. Possibly my general recognition of this plant included Acalypha Virginica L. also, but such was not handled or recognized.

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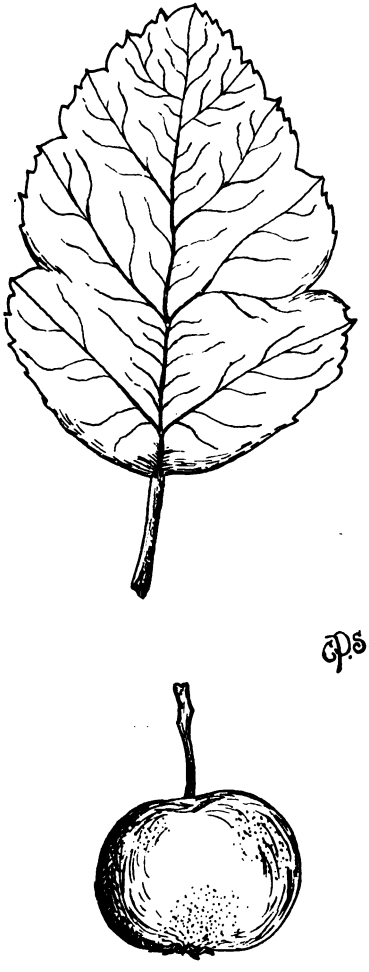

WILD CRAB APPLE
(*Malus coronaria*).

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EUPHORBIA MACULATA L. Spotted Spurge. Frequent near dwellings, along some roads and in stubble fields.

EUPHORBIA NUTANS Lag. Upright Spotted Spurge. Very abundant in open places, corn fields and stubble fields especially.

EUPHORBIA COROLLATA L. Flowering Spurge. Very common, especially eastwardly, in opens, cornfields, neglected areas, along borders of woods and in open thickets. Mostly in dry soils.

EUPHORBIA COMMUTATA Eugelm. Tinted Spurge. An early spring form, disappearing in May or June. Reported by Mr. Holton.

RHUS COPALLINA L. Black Sumac. Abundant at the edges of woods, composing a large percentage of many thickets along streams and in opens, practically everywhere upon the Reservation.

RHUS GLABRA L. Scarlet Sumac. Common, but not as plentiful as the preceding. Distribution general.

RHUS RADICANS L. Poison or Three-leaved Ivy. Abundant everywhere as a trailer and climber.

EUONYMUS ATROPURPUREUS Jacq. Burning Bush. Wahoo. Occasional along streams. Noted but in one locality and that along the eastern boundary; but it probably occurs elsewhere in small numbers.

CELASTRUS SCANDENS L. Shrubby Bittersweet. Not common, but possibly more so than my citation indicates. Found by me only along the stream of the extreme southeastern corner.

IMPATIENS BIFLORA Walt. Spotted Touch-me-not. This very delicate watery-stemmed plant is very common along all the streams and in moist places in the beds of the ravines.

CEANOTHUS AMERICANUS L. New Jersey Tea. This shrub is very common on the tops and southern exposures of the knobs, especially the southern range. It is there in rich soil and doing most excellent service in holding the soil in place. This plant should be recognized and considered when removing or planting timber, etc.

VITIS LABRUSCA L. Fox Grape. Recorded by Mr. Holton as rare.

VITIS AESTIVALIS Michx. Summer Grape. Quite common and of very general distribution, being frequent in rich and dry

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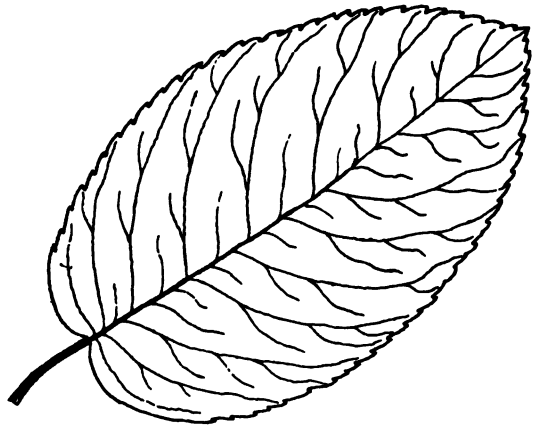
PLATE 31.



SERVICE BERRY

(*Amelanchier Canadensis*).

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woods and thickets, as a climber; and covering considerable areas on barren untimbered knob sides, as a bushy trailer.

VITIS CORDIFOLIA Michx. Frost Grape. Frequent along streams, but of interrupted distribution.

PARTHENOCISSUS QUINQUEFOLIA (L.) Planch. Virginia Creeper. Five-leaved Ivy. Very common. Distribution strictly general.

MALVA ROTUNDIFOLIA L. Common Mallow. Confined to the vicinity of houses. Not common.

SIDA SPINOSA L. Pickly Mallow. Reported by Mr. Holton. Probably limited in distribution.

ASCYRUM HYPERICOIDES L. St. Andrews' Cross. Found frequently, here and there, in dry soil, especially along the wagon ways of the central lowlands.

HYPERICUM PROLIFICUM L. Shrubby St. John's-wort. Mr. Holton reports that at least one "bush" of this species exists on the Reservation. It is probably occasional along streams of the lowlands.

HYPERICUM MACULATUM Walt. Corymbed St. John's-wort. Very common in moist or dry soil, in open neglected places, along streams and roads in rich or poor soil.

HYPERICUM MUTILUM L. Dwarf St. John's-wort. Abundant in moist meadows, where not crowded out by more vigorous forms. Distribution necessarily limited.

SAROTHRA GENTIANOIDES L. Pine Weed. One of the rarest plants on the Reservation, as also in the State. I found one lone specimen in the barren oak district and also a small limited patch in the dry sterile opens of the southwestern lowlands. A strong indication of poor soil.

LECHEA RACEMULOSA Michx. Oblong-fruited Pin-weed.

LECHEA TENUIFOLIA Michx. Narrow-leaved Pin-weed. These two barren-looking plants were found plentifully in sterile soil of the level territory south and west of the Slam place, and westward on dry exposed knob sides of southern exposure. These two plants have been carefully handled and the determination as given above is without question. Neither are given in Dr. Coulter's list of the State flora, but the range of each, as given by Britton and Brown, includes Indiana.

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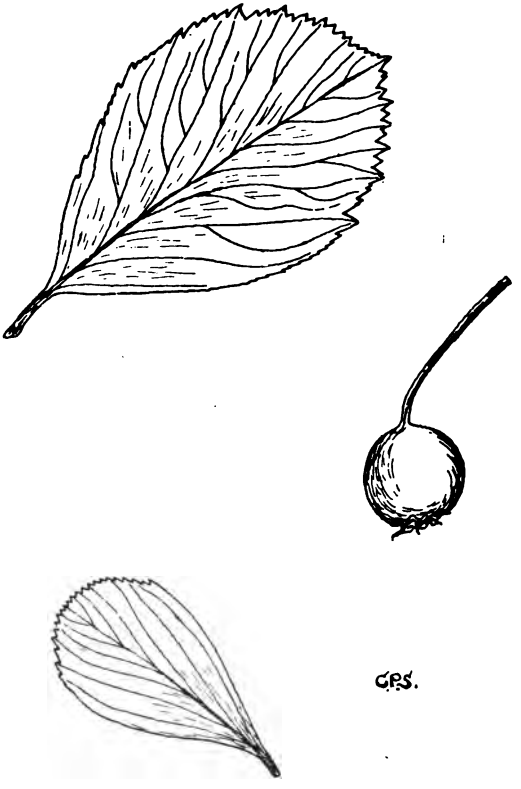

COCKSPUR THORN

(*Cratægus Crus-Galli*).

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VIOLA PALMATA L. Blue Violet. Reported by Mr. Holton, as are also the following:

VIOLA OBLIQUA Hill. Common Blue Violet.

VIOLA SAGITTATA Ait. Arrow-leaved Violet.

VIOLA PUBESCENS Ait. Hairy Yellow Violet.

VIOLA CANADENSIS L. Canada Violet.

PASSIFLORA LUTEA L. Yellow Passion-flower. Undoubtedly upon the Reservation but not actually observed there. I found it commonly in a wheat stubble field just across the northern boundary and also in a thicket only a few yards south of the Reservation line.

PARSONSIA PETIOLATA (L.) Rusby. Tar Weed. Reported by Mr. Holton.

LUDWIGIA ALTERNIFOLIA L. Rattle-box. Very common, at least in the lowlands of the southwestern corner. Mostly in moist places, but also in dry ditches and gutters along some roads.

EPILOBIUM COLORATUM Muhl. Purple-leaved Willow-herb. Found sparingly in low moist places along waterways.

ONAGRA BIENNIS (L.) Scop. Generally abundant in dry or moist soil, almost everywhere in open and neglected places. In the deep ravines it reaches a height of from five to eight feet, with looser foliage and inflorescence, the pods being smaller and comparatively much more slender.

KNEIFFIA FRUTICOSA (L.) Raimann. Sundrops. As far as noted, confined to open moist low grounds near the southeastern corner.

CIRCAEA LUTETIANA L. Enchanter's Night-shade. Frequent in the richer woods and thickets.

ARALIA SPINOSA L. Hercules Club. Frequent in rich sandy soil, where such occurs upon the knob sides. Principally limited to the southern exposure of the Hollister Knob and one of the northern slopes along the northern boundary. Probably doomed to extinction.

ARALIA RACEMOSA L. Spikenard. Occasional in rich soil along shaded streams.

PANAX QUINQUEFOLIUM L. Ginseng. Sang. Once common; now rare or occasional. In similar situations as the preceding plant.

DAUCUS CAROTA L. Wild Carrot. On the Hollister knob. Of recent introduction there and about Henryville. Several per-

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PLATE 33.

GLANDULAR THORN
(*Crataegus rotundifolia*).

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sons called my attention to this now common plant and remarked about its being a newcomer.

ANGELICA VILLOSA (Walt.) B. S. P. Pubescent Angelica. Frequent in dry soil locally, on knob sides and below. As far as I can learn, this is another new record for Indiana.

THASPIUM TRIFOLIATUM AUREUM (Nutt.) Britton. Occasional in moist soil along streams.

ERYNGIUM AQUATICUM L. Button Snakeroot. Rattlesnake-master. Very interesting as one of the three plants so characteristic of the Barren Oak region, as discussed above.

SANICULA CANADENSIS L. Short-styled Black Snakeroot. Common in the richer woods and thickets. Probably S. MARYLANDICA L. is included in my general survey of this plant, though all specimens examined closely were Canadensis.

WASHINGTONIA CLAYTONI (Michx.) Britton. Woolly Sweet Cicely. Frequent in the richer woodland, in lowlands or mouths of ravines.

WASHINGTONIA LONGISTYLIS (Torr.) Britton. Smooth Sweet Cicely. Occasional in similar situations.

CICUTA MACULATA L. Water Hemlock. Common along streams.

DERINGA CANADENSIS (L.) Kuntze. Honewort. Frequent in moist rich soil near waterways, in woodland.

ERIGENIA BULBOSA (Michx.) Nutt. Pepper-and-salt. I found no trace of it, but Mr. Holton reports it. Known to some as "Harbinger of Spring."

GAYLUSSACIA FRONDOSA (L.) T. & G. Tangleberry. Common in the dry woodland of the southwestern lowlands. Occasional elsewhere. Fruit edible.

GAYLUSSACIA RESINOSA (Ait.) T. & G. High-bush Huckleberry. Much more abundant than the last and generally distributed in dry woodland of both lowland and knob region. The main source of edible huckleberries in the "Knob Region."

VACCINIUM STAMINEUM L. Squaw Huckleberry. Buckberry. The most abundant of the huckleberries on the Reservation. In dry soil everywhere. Fruit large, yellowish green to pale bluish when ripe, falling off the bushes about August 1st to 15th. The berries are considered inedible and are not gathered, at least in the vicinity of the Reservation.

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RED FRUITED THORN
(*Crataegus mollis*).

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LYSIMACHIA QUADRIFOLIA L. Whorled Loosestrife. Frequent in one dry open area within the Barren Oak region and also in rich moist shaded soil near certain streams. Evidently exceptional under the latter conditions.

STEIRONEMA LANCEOLATUM (Walt.) Gray. Lance-leaved Loosestrife. Common in the low moist portions of the southwestern lowlands.

CHIONANTHUS VIRGINICA L. Fringe-tree. Flowering Ash. In cultivation about Henryville and said by Mr. Raymond Freeman, to be in wild state (presumably escaped) upon the Reservation. I sought for it but failed to find any evidence of it. Its natural range does not include Indiana, and its probable occurrence upon the Reservation would not be credited except for the positive statements of Mr. Freeman.

SABBATIA ANGULARIS (L.) Pursh. Rose Pink. Very abundant in moist or dry rich soil in the lowlands of the southwestern corner. Also found sparingly, and in poorer development, upon the crest of the southern ridge.

FRASERA CAROLINENSIS Walt. American Columbo. Occasional in the drier woodland. Noticed on knob sides and in the lowlands. Said to have been abundant formerly in a certain section.

APOCYNUM CANNABINUM L. Indian Hemp. Frequent in various soils along thickets and in moist levels along streams in the open.

ASCLEPIAS TUBEROSA L. Butterfly Weed. One thrifty plant in full bloom was the only noticed representative of this species.

ASCLEPIAS SYRIACA L. Common Milkweed. Occasional in cultivated areas.

IPOMOEA PANDURATA (L.) Meyer. Wild Potato Vine. Locally known as "Wild Yam." Abundant in several sterile fields and waste levels of the lowlands. Also occasional in the mouths of the deep ravines.

IPOMOEA LACUNOSA L. Small-flowered White Morning-glory. Common in the dry waste opens of the southwestern lowlands. Not recognized elsewhere.

IPOMOFA HEDERACEA Jacq. Ivy-leafed Morning-glory. Abundant in several cornfields.

CONVOLVULUS SEPIUM L. Hedge Bindweed.

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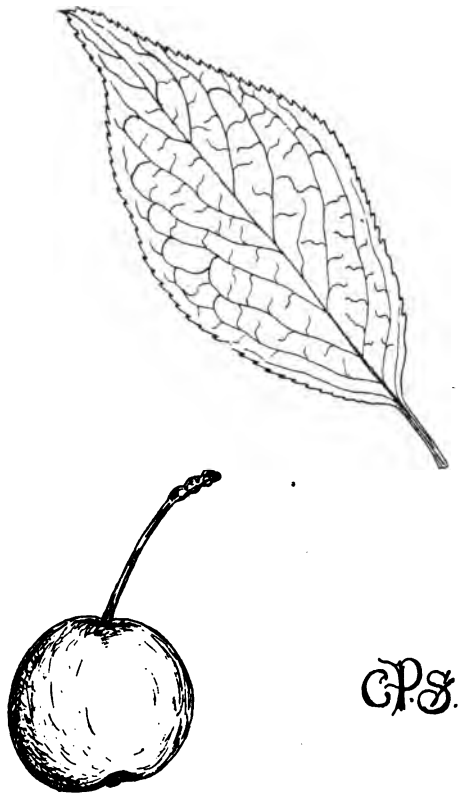
PLATE 35.



WILD RED PLUM
(*Prunus Americana*).

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CONVOLVULUS ARVENSIS L. Small Bindweed. Both these are reported by Mr. Holton. Am surprised to know that I overlooked them. Their distribution is probably local.

CUSCUTA CEPHALANTHI Eugelm. Button-bush Dodder. Abundant in almost all moist places along all waterways upon the Reservation. At least one other dodder was noticed, but was not specifically determined.

PHLOX PANICULATA L. Garden Phlox. Common along one or two wooded streams.

PHLOX DIVARICATA L. Wild Blue Phlox. Common in woodland, possibly only in the lowlands.

POLEMONIUM REPTANS L. Greek Valerian. Noted along one stream along the eastern boundary.

HELIOTROPIUM INDICUM L. Wild Heliotrope. Reported by Mr. Holton as of very local distribution along a certain stream.

CYNOGLOSSUM VIRGINICUM L. Wild Comfrey. Common in the richer woodland, rather locally.

LAPPULA VIRGINIANA (L.) Greene. Virginia Stickseed. Very common and generally distributed in moist soil along streams, especially in rather open places in woods.

LITHOSPERMUM OFFICINALE L. Gromwell. Reported by Mr. Holton.

VERBENA URTICIFOLIA L. White Verbena. Occasional about dwellings and along roads through the opens.

VERBENA HASTATA L. Blue Wild Verbena. Less frequent than the preceding; in similar situations.

TEUCRIUM CANADENSE L. Wood Sage. Quite common along streams in the opens, and in various moist situations.

SCUTELLARIA INCANA Muhl. Downy Skullcap. Very common in moist or dry rich soil in clearings, open thickets and at the borders of woods. Mostly indicative of rich soil.

SCUTELLARIA CORDIFOLIA Muhl. Heart-leaved Scullcap. Much less common than the last. In open thickets along streams, where noted.

SCUTELLARIA PARVULA Michx. Small Scullcap. Frequent in moist soil along some wooded and thicketed streams.

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PLATE 36.

WILD BLACK CHERRY
(*Prunus serotina*).

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SCUTELLARIA CAMPESTRIS Britton. Prairie Scullcap. Common on the dry exposed knob sides. Apparently not heretofore recorded from the State.

MARRUBIUM VULGARE L. White Hoarhound. Introduced by Mr. Richard Enlow about his house. Now spreading rapidly.

NEPETA CATARIA L. Catnip. Frequent about houses, and spreading along wagon ways, etc.

PRUNELLA VULGARIS L. Heal-all. Self-heal. Very abundant. Along roadways, streams, and in moist and dry pastures, etc.

STACHYS AMBIGUA (A. Gray) Britton. Dense-flowered Hedge Nettle. Found sparingly along a certain stream through open woodland, near the center of the Reservation. Not recorded from the State, according to Dr. Coulter; but being within the range assigned to the species by Britton and Brown.

STACHYS CORDATA Riddell. Light-green Hedge Nettle. Common along streams fringed with shrubbery and occasionally in dry soil along roads. Mostly confined to the lowlands

SALVIA LYRATA L. Lyre-leaved Sage. Confined to a very limited area, namely, where a wagon-road comes out of a certain wood of the lowland, near the southern boundary. Not noticed elsewhere.

MONARDA FISTULOSA L. Horsemint. Wild Bergamot. Very common in wet or dry soil in almost all uncultivated opens.

BLEPHILIA HIRSUTA (Pursh.) Torr. Hairy Blephilia. As far as observed, confined to the bottoms of the larger ravines. Not very common.

HEDEOMA PULEGIOIDES (L.) Pers. Pennyroyal. Abundant in dry soils along roads and in various neglected openings.

KOELLIA FLEXUOSA (Walt.) MacM. Narrow-leaved Mountain-mint. Very common in dry soil in various situations, principally along roads and in uncultivated clearings. Most abundant in the southwestern lowlands.

KOELLIA INCANA (L.) Kuntze. Hoary Mountain-mint. A common and characteristic plant of the open thickets and borders of woodland. Found mostly in the richer soil and of more uniform and general distribution than the preceding. This and the last species have a decided odor suggesting sage.

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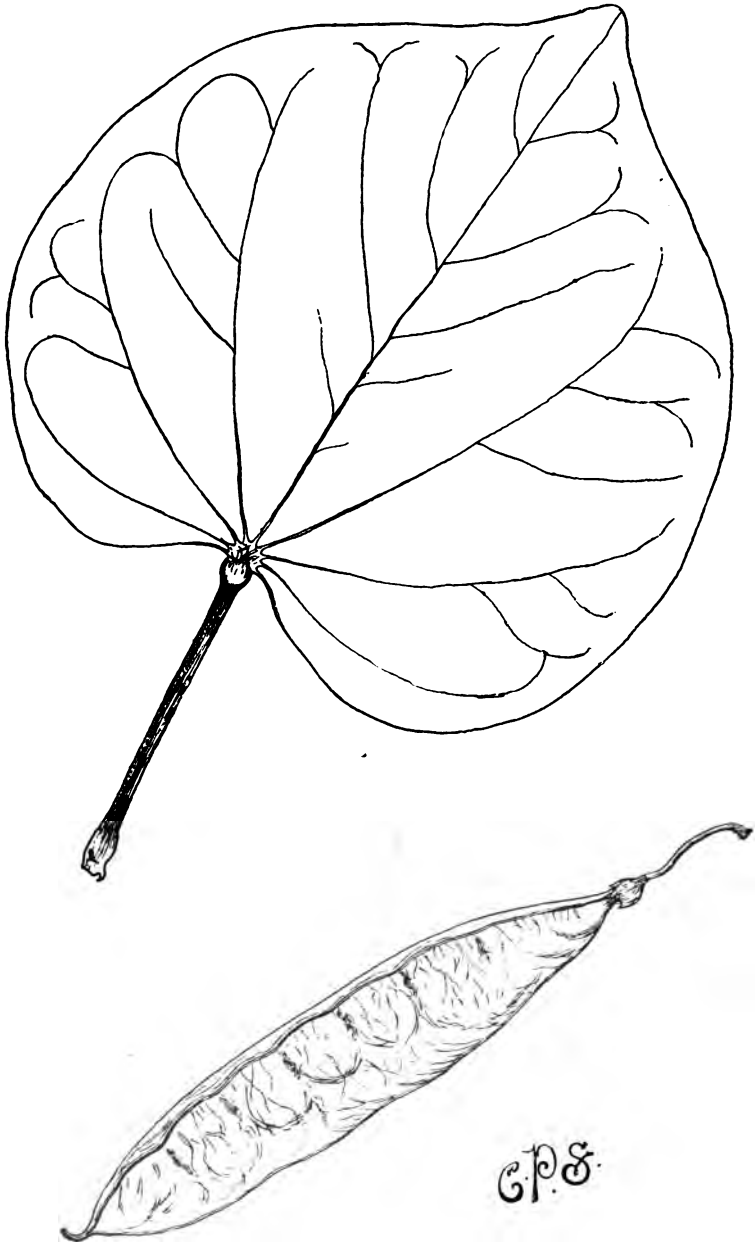
PLATE 37.



REDBUD

(*Cercis Canadensis*).

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Cunila origanoides (L.) Britton. Sweet Horse-mint. This peculiar little shrubby mint is quite characteristic of dry poor soil in woodland. Common in the dry woods of the lowland and also in the "foot-hills" of the knobs.

Lycopus rubellus Moench. Water Hoarhound. Taken in a dry gutter along a road. Probably to be found in greater or less abundance, locally, along streams.

Mentha spicata L. Spearmint. Introduced about the Armstrong dwelling.

Collinsonia Canadensis L. Horse-balm. Frequent in rich shaded soil along streams in woodland. Distribution local.

Physalis lanceolata Michx. Prairie Ground Cherry. A record of Mr. Holton's.

Solanum nigrum L. Black Nightshade. Frequent in waste places near dwelling.

Solanum Carolinense L. Horse Nettle. Very abundant in waste and cultivated fields, in pastures and along roads in open places. A thriving weed.

Verbascum Thapsus L. Common Mullein. Occasional about dwellings and in neglected opens. Not common.

Verbascum Blattaria L. Moth Mullein. Of similar distribution and abundance to the preceding.

Scrophularia Marylandica L. Carpenter's Square. Reported by Mr. Holton. Probably not common and very local upon the Reservation.

Penstemon hirsutus (L.) Willd. Hairy Beard-tongue. Recorded by Mr. Holton.

Penstemon Penstemon (L.) Brit. Smooth Beard-tongue. Occasional along some streams.

Mimulus ringens L. Square-stemmed Monkey-flower.

Mimulus alatus Soland. Sharp-winged Monkey-flower. Both of these plants were noted as common in the large low moist place of the southwestern lowlands.

Ilysanthes attenuata (Muhl.) Small. Short-stalked False Pimpernel. A common little plant in the locality just cited for the two preceding species. This species also seems to have been overlooked heretofore, as regards its presence in Indiana.

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HONEY LOCUST
(*Gleditsia triacanthos*).

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Dasystoma flava (L.) Wood. Downy False Foxglove. Frequent in dry soil, mostly in rather open places in woods and thickets. Well distributed in the central and eastern portions.

Dasystoma Virginica (L.) Britton. Oak-leaved False Foxglove. Frequent within the range of the last, but in more shaded soils, generally.

Gerardia tenuifolia Vahl. Slender Gerardia. Of irregular distribution and soil condition. Found in the dry sterile soil of the Barren Oak region and on the edges of moist low levels in the opens.

Pedicularis Canadensis L. Common Louse-wort. Occasional in dry soil of thickets along the eastern boundary.

Leptamnium Virginianum (L.) Raf. Beech-drops. Parasitic upon the roots of the beech, and therefore found only where that tree occurs. Confined to shaded and moist situations, where dead leaves are abundant.

Tecoma radicans (L.) DC. Trumpet-creeper. Occasional in the dry woods and thickets of the southern limits and more abundant in the greater and lesser ravines of the northern portions, there often in rich soil.

Ruellia ciliosa Pursh. Hairy Ruellia. Occasional in the drier woods, especially along wagon paths in rather open places.

Phryma Leptostachya L. Lopseed. Two specimens noted, widely separated. In comparatively dry, shady woodland. Reported as rare by Mr. Holton also.

Plantago major L. Common Plantain.

Plantago Rugelii Decaisne. Rugel's Plantain. Both these forms were recognized about dwellings. Spreading slowly along wagon paths.

Plantago lanceolata L. English Plantain. Common about dwellings, especially upon the Hollister knob.

Plantago aristata Michx. Large-bracted Plantain. Superabundant upon the Hollister knob, covering large areas to the exclusion of all other plants of similar size and habit.

Houstonia purpurea L. Large Houstonia. Frequent in dry soil of the southwestern lowlands, along roads and in waste open places.

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PLATE 39.

RED MAPLE

(*Acer rubrum*).

Leaf three-fourths natural size.

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Houstonia ciliolata Torr. Fringed Houstonia. Only one clump of plants of this species was noted. This was in dry soil, at the edge of a cornfield.

Cephalanthus occidentalis L. Button Bush. Very common in the low moist places and along most streams, in woods or open.

Diodia teres Walt. Rough Button-weed. Noted only in a very limited range, namely in the dry gutter along the public road through the southwestern lowlands.

Galium circaezans Michx. Wild Liquorice. Common in the richer woods, especially in moist soil along streams.

Galium triflorum Michx. Sweet-scented Bedstraw. Common in woodland, under various soil conditions, as is also

Galium concinnum T. and G. Shining Bedstraw.

Sambucus Canadensis L. Elderberry. Quite frequent along streams and in moist soil generally, but not regularly distributed.

Viburnum acerifolium L. Maple-leaved Viburnum. Common in the richer woodland, especially on the densely shaded knob sides, sloping down into the ravines.

Viburnum molle Michx. Soft-leaved Arrow-wood. Noted amidst dense shrubbery at the edge of a certain wood near the southeastern corner. Not met with elsewhere.

Viburnum prunifolium L. Black Haw. Occasional along streams.

Triosteum perfoliatum L. Horse Gentian. Reported by Mr. Holton.

Triosteum angustifolium L. Narrow-leaved Horse Gentian. I found one plant of this species and looked out for others, but saw no more. Perhaps both this and the last could have been found more or less frequently, in the richer woodland, earlier in the season.

Campanula Americana L. Tall Bellflower. Abundant in rich shaded soil along streams.

Legouzia perfoliata (L.) Britton. Venus's Looking Glass. Common in dry sterile soil on exposed knob sides and in the clearing on top of the Hollister Knob. Mainly indicative of poor soil.

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PLATE 40.

SUGAR MAPLE

(*Acer Saccharum*).

Leaf three-fourths natural size.

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Lobelia cardinalis L. Cardinal Flower. In moist soil along streams. Comparatively rare.

Lobelia syphilitica L. Great Blue Lobelia. Rather common along streams, especially in the deeper ravines.

Lobelia inflata L. Indian Tobacco. Very common in open places, either in dry fields or along streams. Especially common in the small clearings at the foot of the Hollister Knob.

Sonchus asper (L.) All. Spiny Sow-thistle. Occasional in waste places about houses.

Lactuca Scariola L. Prickly Lettuce. Frequent in waste places.

Lactuca Canadensis L. Wild Lettuce.

Lactuca sagittifolia Ell. Arrow-leaved Lettuce. Both of these forms are common to abundant in neglected and waste opens, along roads, etc., the former especially invading cornfields and the edges of woods and thickets.

Lactuca villosa Jacq. Hairy-veined Blue Lettuce. Common in shady moist places along streams and at the borders of richer woods and thickets.

Hieracium Gronovii L. Hairy Hawkweed. Frequent in the drier woodland of both lowland and knob region.

Ambrosia trifida L. Great Ragweed. Horse-weed. Abundant along streams and borders of woodland and thickets.

Ambrosia artemisiaefolia L. Common Ragweed. Frequent in waste places, but especially in grain stubble fields.

Xanthium strumarium L. Cockle-bur. Abundant in cornfields and neglected places; also in moist soil along some streams in the open.

Vernonia fasiculata Michx. Western Ironweed. Very common along streams and in almost all open places and along borders of woodland.

Eupatorium purpureum L. Joe-Pye Weed. "Queen-of-the-Prairie." Common in open thickets and along borders of woods and streams.

Eupatorium sessilifolium L. Upland Boneset. Common in the richer woods, preferring shade.

Eupatorium perfoliatum L. Common Boneset. Also along streams and borders of woods and thickets.

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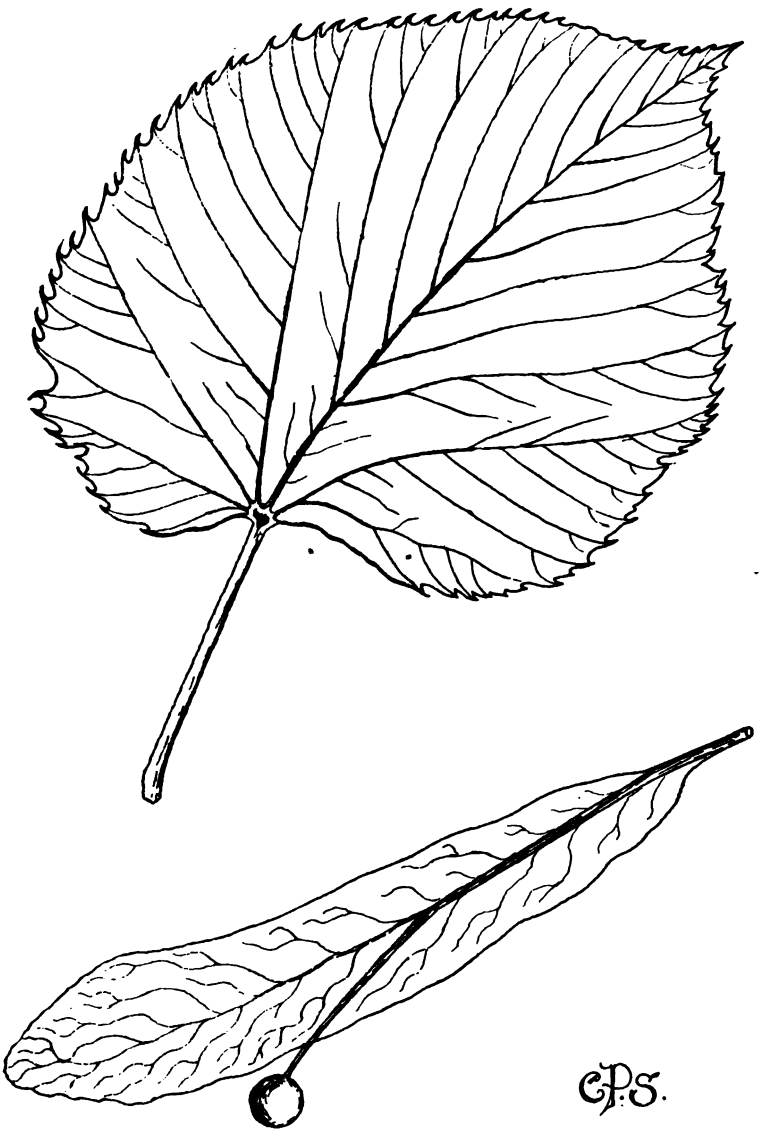
PLATE 41.



LINN

(*Tilia Americana*).

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EUPATORIUM AGERATOIDES L. f. White Snakeroot. Frequent in moist shaded soil along streams.

EUPATORIUM COELESTINUM L. Mist Flower. Found occasionally along roads. Not common.

LACINARIA SQUARROSA (L.) Hill. Scaley Blazing Star. Colic-root. Frequent in dry soil along the crests of the knob-ridges. Heretofore reported from Gibson and Posey counties only.

LACINARIA SPICATA (L.) Kuntze. Common along shaded streams and wagon-paths in the woodland of the eastern lowlands.

SOLIDAGO FLEXICAULIS L. Broad-leaved Golden-rod. Common at borders of woodland.

SOLIDAGO JUNCEA Ait. Sharp-toothed Golden-rod. Abundant in dry uncultivated opens.

SOLIDAGO NEMORALIS Ait. Field Golden-rod. Common. Associated with the last.

EUTHAMIA GRAMINIFOLIA (L.) Nutt. Bushy Golden-rod. In moist places along streams. Frequent.

ASTER PATENS Ait. Late Purple Aster. In dry open woods or fields, common, irregularly distributed. First noted in bloom on August 14th.

ASTER DUMOSUS L. Bushy Aster. Frequent in neglected fields.

ASTER MULTIFLORUS Ait. Dense-flowered Aster. Abundant in waste and cultivated opens, especially along the borders.

ERIGERON ANNUUS (L.) Pers. White Top. Fleabane.

ERIGERON RAMOSUS (Walt.) B. S. P. Slender White Top. Both these forms are common in neglected fields and about houses.

GNAPHALIUM OBTUSIFOLIUM L. Common Everlasting. Very common in the dry fields of the southwestern lowlands.

SILPHIUM TRIFOLIATUM L. Whorled Rosin-weed. Noted only along the stream near the extreme southeastern corner. Probably elsewhere in similar environments.

HELIOPSIS HELIANTHOIDES (L.) B. S. P. False Sunflower. In dry open woods, both in the lowlands and on knob sides.

ECLIPTA ALBA (L.) Hassk. Eclipta reported by Mr. Holton. Found in the moist low ground near the southwestern corner and probably in similar situations elsewhere.

RUDBECKIA HIRTA L. Black-eyed Susan. Abundant in all dry soils of the opens, regardless of elevation.

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FLOWERING DOGWOOD

(*Cornus florida*).

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HELIANTHUS MICROCEPHALUS T. and G. Small Wood Sunflower. Common on the wooded knob sides, especially eastwardly.

HELIANTHUS DIVARICATUS L. Rough Woodland Sunflower. Abundant in almost all woodlands and thickets, except for being less common in the barrens of the lowlands.

HELIANTHUS HIRSUTUS Raf. Stiff-haired Sunflower. Abundant in the range occupied by H. MICROCEPHALUS, as noted above.

VERBESINA HELIANTHOIDES Michx. Abundant in a bushy opening east of the center and frequent elsewhere in dry soil in thickets or along edges of woodland.

VERBESINA ALTERNIFOLIA (L.) Britton. Very common and more generally distributed than the preceding. Found in similar environments.

COREOPSIS TRIPTERIS L. Tall Tickseed. Frequent in somewhat shaded situations along certain streams.

BIDENS CONNATA Muhl. Purple-stemmed Swamp Beggar-ticks. Common in low wet places.

BIDENS FRONDOSA L. Common Beggar-ticks. Very common in wet and dry situations, along streams and in waste places.

BIDENS BIPINNATA L. Spanish Needles. Noted as occasional along the road approaching the Hollister Knob.

HELENIUM AUTUMNALE L. Sneezeweed. In moist soil along streams, in clearings or open woodland. Not very common.

ACHILLEA MILLEFOLIUM L. Yarrow. On the Hollister Knob and along roads, sparingly.

ANTHEMIS COTULA L. Common Dog Fennel. In waste places about houses. Not very common.

CHRYSANTHEMUM LEUCANTHEMUM L. Ox-eye Daisy. Common on the Hollister Knob clearing. Not noted elsewhere.

TANACETUM VULGARE L. Tansy. A thriving clump exists along the road in front of the Armstrong house.

ERECHTITES HIERACIFOLIA (L.) Raf. Fire-weed. Abundant in clearings and open woods, especially westwardly, and regardless of elevation.

MESADENIA ATRIPLICIFOLIA (L.) Raf. Pale Indian Plantain. In moist places at the borders of lowland woods and in the deeper ravines. Not very common.

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PLATE 43.

TUPELO OR BLACK GUM
(*Nyssa sylvatica*).

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ARCTIUM LAPPA L. Burdock. Occasional in waste places near dwellings.

CARDUUS ALTISSIMUS L. Tall Thistle. Abundant along streams and at edges of thickets.

CARDUUS DISCOLOR (Muhl.) Nutt. Field Thistle. Common in waste places, mostly about or near dwellings.

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PLATE 44.

PERSIMMON

(*Diospyros Virginiana*).

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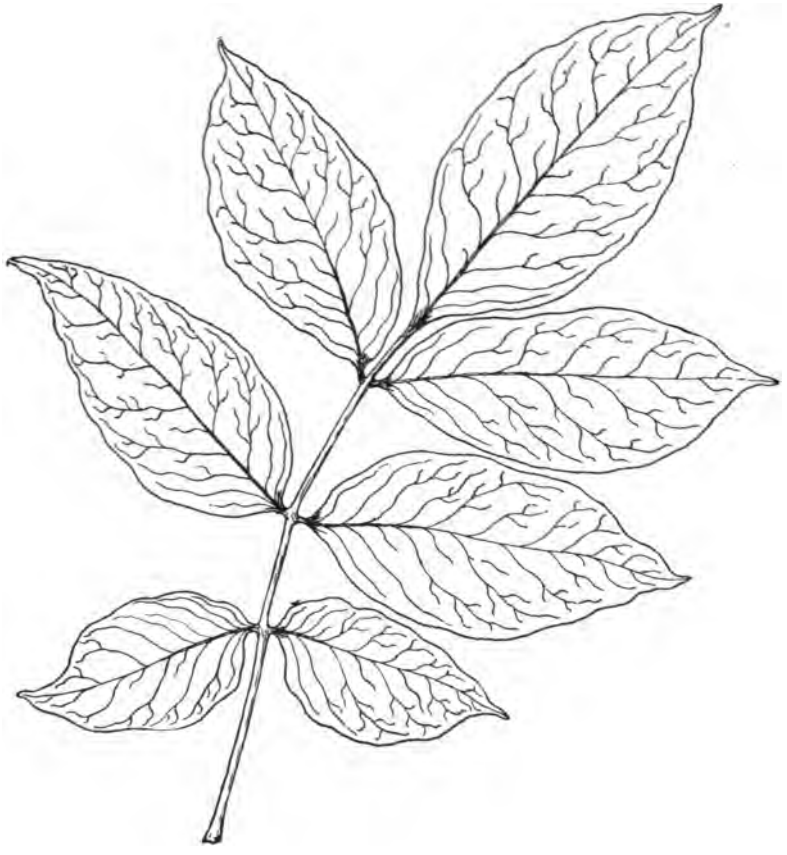
PLATE 45.



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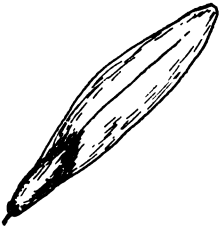

WHITE ASH

(*Fraxinus Americana*).

Fruit full size; leaf three-eighths natural size.

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